JPRS-UMS-85-006

29 July 1985

USSR Report

MATERIALS SCIENCE AND METALLURGY

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USSR REPORT

MATERIALS SCIENCE AND METALLURGY

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UDC 669.15:620.192.43

HEREDITARY EFFECT OF DENDRITE LIQUATION OF TITANIUM AND ZIRCONIUM ON STRUCTURE AND PROPERTIES OF ALUMINUM ALLOYS

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 5, May 85 pp 43-45

FRIDLYANDER, I. N., SETYUKOV, O. A. and RUCH'YEVA, N. V.

[Abstract] Increasing the amount of titanium in an aluminum alloy is known to produce a finer structure and eliminate fan-like structure, but as titanium content nears the limit permitted by standards, some coarseness may also result. The present article discusses chemical and structural features of dendrite formations in the alloy D16ch and V95pch. Content of copper, manganese and titanium, as determined by micro-x-ray spectral analysis, showed D16ch to have 1.3-2.0% Cu and about 1% Ti in central zones, and in dark cells from 2 to 3.6% Cu. Other tests with alloys containing 5.0% zinc, 2.5% manganese and 1.8% copper, and varying amounts of titanium and zirconium showed that in zones with coarse structure, Ti content exceeded the normal amounts by 6-8 times, while zirconium was found in 1.5-2 times the normal amount for the alloy. Increasing smelting temperature of the alloy had little effect. Interdendrite liquation was not eliminated by any of the procedures tested. Figures 3; references 6: 4 Russian, 2 Western.
[175-12131]

UDC 621.771.8

FIBER COMPOSITION MATERIALS FOR STRENGTHENING COMPONENTS OF ALUMINUM AND ITS ALLOYS

Kiev TEKHNOLOGIYA I ORGANIZATSIYA PROIZVODSTVA in Russian No 3, Jul-Sep 84 pp 53-54

GRIBOVSKIY, V. K., CHUTAYEV, I. Kh., cnadidates of technical sciences, BAKAYEV, A. G. and AZARENKO, A. Ye., engineers

[Abstract] Local strengthening is a promising method for increasing the useful life of portions of machinery that are subjected to particularly severe

wear conditions. The present article summarizes attempts to improve the wear characteristics of diesel engine compression rings and ring seats. Work at the Central Institute for Diesel Research in Leningrad has focused on plasma resmelting with simultaneous addition of new alloying materials in the compression ring seat area in order to harden and strengthen it. Attempts to add powders or monolithic fibers of stainless steel or nickel were unsuccessful, but better results were achieved with composition materials based on aluminum and containing nickel, nichrome or steel. Work on these strengthening techniques has been conducted at the BSSR Academy of Sciences and the "Kievtraktorodetal'" Production Association. The continuous feed system for producing such improved pistons is diagrammed and described. The fibers were improved and forging made more stable by an intermittent stretching procedure. Operational tests have indicated that piston life is increased by 1.5-1.7 times by this method.
[170-12131]

UDC 620.17:620.18:669.71'721'5

STRUCTURE AND PROPERTIES OF Al-Mg-Zn CASTING ALLOYS

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 3, Mar 85 pp 56-57

PARKHOMENKO, N. A., GERCHIKOVA, N. S., CHERKASOV, V. V. and POBEZHIMOV, P. P.

[Abstract] Diffraction electron microsopy was used to study the fine structure of casting alloys in the system Al-Mg-Zn as a function of alloying and heat treatment conditions. Analysis of mechanical test data for the alloys established certain regularities: as magnesium content increases, strength increases but ductility decreases. The optimal combination of properties is found at Al-5.5% Mg-2.5% Zn. The major hardening phase of the alloys is the T phase ($Al_2Mg_3Zn_3$) liberated at 160 to 170°C. Upon heating to 190°C or higher, the β phase (Al_3Mg_2) begins to form, first at subgrain boundaries, then throughout the entire body of the grain at temperatures over 200°C. Coagulation of T phase particles and β phase growth lead to a decrease in strength. The best combination of properties of the alloy with optimal composition corresponds to the beginning of the T→β phase transition, observed after aging at 80°C for 8 hours plus 190°C for two hours.
References 2: 1 Russian, 1 Western.
[134-6508]

UDC 669.71'721:621.785.78

DISCONTINUOUS PRECIPITATION IN ALUMINUM-MAGNESIUM ALLOYS WITH HIGH MAGNESIUM CONTENT

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 59, No 1, Jan 85 (manuscript received 24 Apr 84) pp 91-95

BUYNOV, N. N. and KAYGORODOVA, L. I., Institute of Metal Physics, Ukrainian Scientific Center, USSR Academy of Sciences

[Abstract] A study was made of the possibility of reducing the grain size in cast Al-Mg alloys by breakdown of a supersaturated solid solution by a discontinuous mechanism. This analysis of the literature indicates that Al-Mg alloys have a number of peculiarities which distinguish them from aluminum alloys of other systems, including slight natural aging with a recovery at low temperatures, easy breaking of bonds between magnesium atoms and vacancies, forming accumulations of vacancies; rapid development of grain boundary segregations; presence of Bardin-Haring dislocation sources; and initial coherent matrix development of metastable β'-phase particles. Stresses developing in the alloy upon single phase decomposition do not reach the critical state necessary for decomposition of the supersaturated solid solution by the discontinuous mechanism. This plus the high density of β phase particles segrated along grain boundaries prevent decomposition of the supersaturated solid solution during aging. Figures 1; references 26: 12 Russian, 14 Western.
[121-6508]

UDC 669.715.018:621.745

STRUCTURE FORMATION IN SILUMINS UPON RAPID CRYSTALLIZATION

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 3, Mar 85 pp 50-55

MAZUR, V. I., KUTSOVA, V. Z. and UZLOV, K. I., Dnepropetrovsk Metallurgical Institute

[Abstract] Thin films of Al-Si alloys cooled from the liquid state at 10^5-10^6°C/s were stored at -196 to +20°C and their structure and phase composition subsequently studied. Droplets of melt were catapulted to a copper drum rotating at 3000 rpm, melt temperature 1100°C. The structure of the alloys was studied by light and electron transmission microscopy. The phase composition was determined at -196 to +20°C by diffractometry. Where the silicon content is 12.7-23% with significant heating of the melt beyond the melting point, preferential interaction of dissimilar Al-Si atoms occurs. Metastable phases may be formed: cubic, orthorhombic and hexagonal phases, which break down upon cooling to stable phases, the α-solid solution and silicon. Figures 8, references: 14 Russian.
[134-6508]

UDC 669.71:620.17

INFLUENCE OF ALLOYING ELEMENTS AND IMPURITIES ON MECHANICAL PROPERTIES OF COMPLEX SILUMINS

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 3, Mar 85 pp 57-59

BYCHKOV, Yu. B., BALANAYEVA, N. A., OFENGENDEN, A. A., KUPERSHTOK, Yu. Ye., All-Union Scientific Research Institute of Secondary Nonferrous Metallurgy, Donetsk

[Abstract] A study is made of the influence of alloying elements (Si, Cu, Mn, Mg) and impurities (Fe and Zn) over a broad range of concentrations on mechanical properties of Al-Si-Cu alloys in the cast state. The work was performed by passive experimentation with alloys containing 4-10% Si, 0.5-5% Cu, 0.5-0.9% Fe, 0.2-0.8% Mn, 0-3% Mg and 0.5-2.4% Zn. Mechanical properties of the alloys were determined using the individually cast specimens, with five parallel measurements of all properties for each melt. The equations are derived to describe the variation of yield point and ultimate tensile strength as a function of content of the various elements. It is found that as zinc concentration increases, short-term tensile strength of the alloys increases slightly, yield point still more. Increasing copper concentration significantly increases tensile strength, yield point and hardness, while elongation decreases. At lower concentrations, silicon decreases tensile strength, increasing it at higher concentrations. Iron decreases the positive influence of silicon on tensile strength. Zinc partially compensates the influence of copper on short-term strength. Magnesium increases tensile strength at contents of less than 1.6%. Figures 2; references: 5 Russian.
[134-6508]

UDC 620.184.6:669.715

STUDY OF FRACTURES IN CAST PARTS OF HIGH-STRENGTH ALUMINUM ALLOY

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 3, Mar 85 pp 60-62

LALAYAN, E. A., BRODSKAYA, R. M. and ZOLOTAREV, V. S.

[Abstract] Results are presented from studies on the quality of cast parts made by counterpressure casting of high-strength aluminum alloy AMKh-605, and Al-Cu-Mn-Cr alloys (5.6-6.4% Cu, 0.25-0.55% Mn, 0.20-0.55% Cr, 0.20-0.45% Ti, 0.08-0.25% Zr, ≤0.25% Fe, ≤0.25% Si, ≤0.05% Mg). Chill castings were heat treated by quenching from 450°C (20 hours) in water, aging at 160°C for five hours with cooling in air. Fractograms of tensile specimens are presented. Scanning electron microscopy allows an ambiguous determination of the cause of

failure of a part, be it at initial crystallization crack defects or burns, and also allows a relationship to be established between structure and mechanical properties. References: 4 Russian.
[134-6508]

UDC 669.71-154:669.3-154:539.217

STUDY OF PERMEABILITY OF TWO-PHASE ZONE IN ALUMINUM AND COPPER ALLOYS

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: CHERNAYA METALLURGIYA in Russian No 1, Jan 85 (manuscript received 21 Feb 84) pp 4-6

KOLYADINA, N. Yu., MATVEYEV, Yu. Ye. and BORISOV, V. T., Central Scientific Research Institute of Ferrous Metallurgy

[Abstract] A study is made of permeability in alloys such as silumin (Al-6% Si-0.3% Mg; Al-4% Cu) and tin bronze (Cu-10% Sn; Cu-15% Sn). The method for determining permeability coefficient was based on measurement and analysis of attenuation of twisting oscillations of a terroidal specimen of the alloy in the solid-liquid state. The alloy was crystallized or melted at a predetermined rate, which varied between 0.5 and 4.5°C/min. At a fixed temperature determining the cross section of the liquid phase and dendritic structure of the two-phase zone, the specimen was twisted with an elastic filament along the axis of the torus and allowed to oscillate, the amplitude of the oscillations being measured at fixed time intervals. The change in coefficient of permeability and cross section of two-phase zone is shown to be similar over the solidification temperature interval. The more rapidly the alloy was crystallized or melted, the less the coefficient of permeability.
Figures 2; references: 6 Russian.
[125-6508]

UDC 669.715:621.77

PROPERTIES AND USE OF NEW HIGHLY WORKABLE ALUMINUM ALLOYS IN THE ECONOMY

Moscow TSVETNYYE METALLY in Russian No 2, Feb 85 pp 61-64

YELAGIN, V. I. and ZAKHAROV, V. V.

[Abstract] Highly workable alloys include those based on Al-Mg-Si, such as AD31 and 01320 and Al-Zn-Mg alloys such as 1915, 1925, 1935 and 1955. These alloys can be pressed at flow rates an order of magnitude higher than traditional alloys, the maximum rate and surface smoothness of pressed products being determined by the morphology of excess phase particles. Production of excess phase particles in more compact shapes with uniform distribution through

the volume of the alloy helps to increase the maximum possible flow rate and improve surface smoothness. The use of these alloys can allow a savings of scarce alloying additives such as magnesium and more complete utilization of secondary aluminum raw materials.
[117-6508]

UDC 620.17:620.18:669.715

INFLUENCE OF DEGREE OF DEFORMATION ON STRUCTURE AND PROPERTIES OF NATURALLY AGED ALLOY 1163

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 2, Feb 85 pp 61-62

LESHCHINER, L. N., KISHKINA, S. I. and GERCHIKOVA, N. S., All-Union Institute of Aviation Materials

[Abstract] A study was made of the influence of deformation of rolled products on the properties of naturally aged aluminum alloy 1163 (type D16ch) with reduced content of iron and silicon (4.3% Cu, 1.4% Mg, 0.43% Mn, 0.12% Fe, 0.05% Si). Plates 6-8 mm thick were cut from hardened, straightened and naturally aged slabs and rolled at normal temperature with 7, 11, 15, 20 and 25% deformation. The plates were straightened by stretching after rolling with residual deformation of about 1% to produce a flat surface. The properties of the specimens were determined in extension, the work of fracture of a specimen with a crack and low-cycle fatigue properties were determined, and the dislocation structure was studied by diffraction electron microscopy. Rolling deformation over 7% was found to lead to a decrease in fracture toughness. After 11-15% deformation, the increase in strength properties is greater than after 7% deformation, with the same ductility and fracture toughness, homogeneous distribution of dislocations and low-cycle fatigue properties no less than in the initial, naturally aged state.
[107-6508]

UDC 601.78:669.715

APPEARANCE OF SUPERPLASTICITY EFFECT IN ALUMINUM ALLOYS WITH LITHIUM

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 2, Feb 85 pp 62-63

FRIDLYANDER, I. N., EKHINA, Ye. V., KUNYAVSKAYA, T. M. and LIKIN, V. L.

[Abstract] A study was made of the influence of lithium content on the superplasticity characteristics of aluminum alloys containing 5.8-6.2% Mg, 1.7-2.55% Li, 0.1% Cr, and 0.1% Fe. Ingots 70 mm in diameter were cast in a

water-cooled mold, then bars 18 mm in diameter were produced by direct pressing at 400-420°C. Temperature-speed tests of specimens of the alloys studied in extension were performed on a test device with a tubular electric furnace. The favorable influence of lithium on the characteristics of superplasticity of the aluminum alloys was found to result from a decrease in grain size and an increase in diffusion processes along grain boundaries. The superplasticity effect appears in alloys containing over 2% Li. Figures 1.
[107-6508]

UDC 669.017.3

PRELIMINARY ANNEALING ON CRYSTALLIZATION OF AMORPHOUS $Fe_{80}Si_6B_{14}$ ALLOY

Moscow IZVESTIYA VYSSHIKH UCHEBNYKHZAVEDENIY: CHERNAYA METALLURGIYA in Russian No 1, Jan 85 (manuscript received 3 Jul 84) pp 152

SKAKOV, Yu. A., KOZHEVNIKOVA, V. L. and REYKH, P., Moscow Institute of Steels and Alloys

[Abstract] The purpose of this work was to study the influence of preliminary low temperature treatment on crystallization of the amorphous alloy $Fe_{80}Si_6B_{14}$ by x-ray methods. The alloy was produced in the amorphous state by cooling in the liquid state as a strip 10 mm wide and about 40 μm thick. Cooled specimens were subjected to isothermal annealing at 250, 300 and 350°C, holding one hour. The specimens were then held from 30 minutes to 2.5 hours at the crystallization point of the alloy (430°C). A 2 μm thick layer was removed by electrolytic polishing from either side of the specimens after heat treatment. Analysis of the specimens showed no significant differences from results obtained in the initial specimens. This indicates that stabilization of the amorphous matrix has a volumetric nature, i.e., is not related to changes in the state of the surface or redistribution of zonal stresses. Figures 1.
[125-6508]

UDC 669.15'781'26:539.213

INFLUENCE OF CHROMIUM ON CRYSTALLIZATION OF AMORPHOUS Fe-B ALLOYS

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 59, No 1, Jan 85 (manuscript received 28 Apr 84) pp 165-170

KALOSHKIN, S. D., ZAYTSEV, A. K., MOCHALOVA, T. Yu., MOLOTILOV, B. V., OVCHAROV, V. P. and TIMILIN, I. A., Moscow Institute of Steel and Alloys

[Abstract] The purpose of this work was to determine the parameters of crystallization (temperature, heats and effective energies of activation) of amorphous iron-boron alloys containing chromium. Compositions studied included:

$Fe_{85-x}Cr_xB_{15}$ (where x-0, 2, 5, 10 15 and 18 at.%) and

$Fe_{90-y}Cr_{10}B_y$ (where y-12, 14, 15 and 18 at.%).

Specimens were obtained by cooling a melt on a spinning drum as a strip 1-2 mm wide and about 20 μm thick. Studies were performed with a scanning microcalorimeter with continuous heating at 2, 4, 8, 16 and 32" per minute. The increase in thermal stability of amorphous iron-boron alloys observed upon addition of chromium is related to the following factors: chromium prevents diffusion flow of boron away from locations of future iron-based solid solution crystals; the addition of chromium decreases the heat of crystallization; chromium may influence the initial structure of the amorphous alloys.
Figures 6; references 9: 3 Russian, 6 Western.
[121-6508]

UDC 539.213:539.52

RELATIONSHIP OF THERMAL EXPANSION OF AMORPHOUS METAL ALLOYS WITH THEIR HIGH TEMPERATURE PLASTIC PROPERTIES

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 59, No 1, Jan 85 (manuscript received 28 Jun 84) pp 204-205

KHONIK, V. A., KONOPKIN, A. N. and ZELENSKIY, V. A., Voronezh Polytechnical Institute

[Abstract] The amorphous metal alloys $Pd_{77.5}Cu_6Si_{16.5}$ and $Co_{70}Fe_5Si_{15}B_{10}$ studied were obtained by quenching from the liquid state. The specimens were 30 to 50 μm thick and 0.7 to 1.5 mm wide. Data on thermoexpansion and differential scanning calorimetry are presented. The specimens were heated at 0.07 K/s to an assigned temperature, then deformation was immediately begun at $3.5 \cdot 10^{-2}$ mm/s. Study of thermal expansion can reveal amorphous metal alloys which may be superplastic. Manifestation of the superplasticity effect in these alloys requires a crystallization of the material not begun before the glass point is reached. Maximum plasticity is found in amorphous metal alloys in which the interval between the crystallization point and the glass point is broadest. Figures 2; references 7: 3 Russian, 4 Western.
[121-6508]

UDC 669.25:373.311.3

ON ANISOTROPY OF MEAN ELECTRICAL RESISTANCE OF BERYLLIUM

Moscow IZVESTIYA AKADEMII NAUK SSSR: METALLY in Russian No 2, Mar-Apr 85 (manuscript received 18 Apr 83) pp 60-61

PLETENETSKIY, G. Ye. and KOSHKAREV, G. S., Khar'kov

[Abstract] Data on mean electrical resistance (MER) of beryllium monocrystals and its temperature dependency in previous research have been contradictory. The present article reports on study of MER anisotropy in monocrystals of 99.99 and 99.6% purity in a broad temperature range from 4.2 to 1535°K. Results showed that in a cryogenic range, anisotropy grew rapidly as temperature increased and was not related to impurity content. In a medium range of 273-1023°K, a more complex pattern emerged, where impurities brought some increase in anisotropy, while at higher temperatures it declined as the state of impurities changed. Figures 1; references 8: 2 Russian, 6 Western. [164-12131]

UDC 669.24'718.4:669.24'26

COMPLEX NICKEL-ALUMINIDE COATINGS ON NICKEL-CHROMIUM ALLOY EP648-VI

Moscow IZVESTIYA AKADEMII NAUK SSSR: METALLY in Russian No 2, Mar-Apr 85 (manuscript received 16 Sep 83) pp 157-160

MONAKHOVA, L. A., LAZAREV, E. M., NOVILOV, V. N., ZAKHAROV, B. M., VARIGIN, A. B., LAPIDOVSKAYA, L. A. and DIKAYA, K. I., Moscow

[Abstract] Studies have shown that oxidation of high chromium content Ni-Cr alloys at temperatures above 1000°C is governed by gas acquisition and evaporation of alloying elements from the metal, leading to impoverishment of the chromium and resultant intercrystalline corrosion and loss of temper. The present article reports on study of the structure of the alloy EP648-VI with various coatings after oxidation at 1150°C for 24 hours. Coatings were applied by gasothermal spraying and vacuum diffusion calorization. After the thermal treatment, samples were examined metallographically to show that oxygen acquisition and chromium loss were in balance. X-ray phase and electronographic analyses showed that the coatings applied by plasma spraying contained the intermetallide Ni_3Al as the basic phase, with a spinel cinder, while coatings applied by diffusion calorization had both NiAl and Ni_3Al intermetallides in the coating, and cinders of alpha-Al_2O_3 and spinel. The sub-zone of spinel that formed prevented oxygen penetration and protected the alloy from loss of chromium and subsequent deterioration. Thus, processes that provide such an impenetrable zone are an important part in the manufacture of such coated alloys. Figures 2; references 10: 2 Russian, 8 Western.
[164-12131]

UDC 621.438:621.793.14

INFLUENCE OF Co-Cr-Al-Y COATINGS ON PHYSICAL AND MECHANICAL PROPERTIES OF EI-893 STEEL IN GT-100 TURBINE DRIVE VANES

Kiev PROBLEMY SPETSIAL'NOY ELEKTROMETALLURGII in Russian No 1, Jan-Mar 85 (manuscript received 23 Apr 84) pp 34-41

MOVCHAN, B. A., MALASHENKO, I. S., NIKITIN, V. I., RUBNIKOV, A. I., BELOLIPETSKIY, Yu. P., KLYTSINA, A. M., LEVIN, A. Ye., SKLYAROV, Yu. D., VASHCHILO, N. P., YAKOVCHUK, K. Yu. and DUBROVSKIY, L. I., Institute of Electric Welding imeni Ye. O. Paton, Ukrainian Academy of Sciences, Kiev; Central Design and Technological Institute imeni Polzunov, Leningrad; Central Scientific Research Institute of Heavy Machine Building, Moscow; "Leningrad Metals Plant" Production Association; All-Union Technological Institute imeni F. E. Dzerzhinskiy, Moscow; "Mosznergo," Moscow Power System, Moscow

[Abstract] Coatings of Co-Cr-Al-Y produced by vacuum precipitation were used to protect the drive vanes of a high-pressured peak load gas turbine. Coatings containing 21-23% Cr, 11-12% Al and up to 0.1% Y were obtained by precipitation in a vacuum in an electron beam evaporator. The vanes were made of deformed heat resistant EI-893VD nickel alloy. After application of the protective layer the parts were subjected to standard heat treatment and shot peening, followed by 2-stage aging under standard conditions. The diffusion layer consisted mainly of (Ni, Co)Al intermetallides and of carbide particles, microhardness 4200-4600 MPa, 900-1000 MPa higher than the base metal. Optical and electron microscopy revealed that there were no significant changes in the structure or phase composition of the base metal. Laboratory testing revealed that the coatings reliably protected the nickel alloys under static stress conditions at 800 and 850°C in gas turbine fuel ash and air. Additional aging increased the corrosion durability of the coatings. Fatigue strength was satisfactory under normal operating conditions. Figures 7; references 12: 10 Russian, 2 Western.
[122-6508]

UDC 539.62+537.2

ELECTRIFICATION OF FILLED POLYETHYLENE COATINGS IN FRICTION WITH METAL

Minsk VESTSI AKADEMII NAUK BSSR in Russian No 1, Jan-Mar 85 (manuscript received 20 Oct 83) pp 38-42

MIRONOV, V. S., Institute of Mechanics of Metal-Polymer Systems, Belorussian Academy of Sciences

[Abstract] A study is presented of the influence of the electrophysical nature and concentration of dispersed filler in polyethylene coatings on the degree

and kinetics of relaxation of the charge arising upon friction of the coatings with metal. Repeated experiments established that polyethylene coatings in friction with metal are charged negatively. When a filler is included in high density polyethylene the polarity of the charge of the material remains negative. Electron microscope studies of the surface of filled high density polyethylene coatings showed that friction, as a result of deformation and wear, slightly changes the shape of particles of nickel and teflon in thin surface layers, the particles remaining separated by intermediate layers of the polymer while graphite particles are spread over the polymer surface, increasing the surface electric conductivity of composite coatings containing graphite. This causes charge dissipation to dominate over charge growth in graphite-filled coatings. Other fillers may increase the electric charge and residual charge. Figures 3; references 11: 9 Russian, 2 Western.
[166-6508]

UDC 548.735

INFLUENCE OF TEXTURE OF TITANIUM NITRIDE COATINGS ON WEAR RESISTANCE OF CUTTING TOOLS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 2, Feb 85 (manuscript received 15 Jul 83) pp 40-43

PLATONOV, G. L. and ANIKIN, V. N., All-Union Scientific Research Institute of Refractory Metals and Hard Alloys

[Abstract] Previous works have reported the possibility of producing textured coatings, but none has discussed the type of texture actually obtained or its influence on the operational properties of hard alloy tools with such coatings. Studies were performed on flat plates of VK6, T5K10 and TT10K8B hard alloys, onto which coatings of titanium nitride were applied from a gas phase consisting of a mixture of titanium tetrachloride and nitrogen in a current of hydrogen at 900-1150°C. Textures appeared regardless of metal substrate at 1050°C and continued through 1150°C. The type of texture in all cases was axial, varying with base alloy and precipitation temperatures. Comparative laboratory testing of the plates was performed, indicating that in titanium nitride coatings precipitated under the experimental conditions, axial growth textures, both monaxial and biaxial, are formed. Figures 2; references 6: 2 Russian, 4 Western.
[130-6508]

UDC 621.785.3

INFLUENCE OF ANNEALING ON HARDNESS OF VACUUM-DIFFUSION CHROMIUM COATING ON LOW-CARBON STEEL

Kiev TEKHNOLOGIYA I ORGANIZATSIYA PROIZVODSTVA in Russian No 4, Oct-Dec 84, pp 35-36

YANENSKIY, N. Ye., MEL'NIK, P. I., GALYKO, A. V., NADVORNYY, B. N., STETSENKO, A. S. and YANENSKIY, V. N., Engineers

[Abstract] The Kirovograd Institute of Agricultural Machine Building has studied the possibility of increasing hardness and wear resistance of vacuum-diffusion chromium coatings on type VSt3ps steel. Specimens 25 mm in diameter and 30 mm high were vacuum chrome plated to a layer thickness of 1.2-1.4 mm, with an alpha solid solution of chromium in iron with a transition layer 40 - 50 μm thick at the substrate consisting of a chrome eutectoid. The microhardness of the alpha solution was 180-220 kgf/mm^2, of the eutectoid - 240 kgf/mm^2. Specimens were then annealed at °50 and 1050°C for three to five hours. Sections were cut from the annealed specimens to study the structure, distribution of carbide-forming elements and microhardness. Analysis of the data showed that increasing time and temperature of annealing increased microhardness of the vacuum chrome-plated layer by a factor of 1.5-2 while simultaneously increasing the thickness of the hardened layer. The eutectoid sublayer completely disappears in this process.
[169-6508]

UDC 621.793.71

STUDY OF PROPERTIES OF GAS-THERMAL COATINGS OF COMPOSITE NICHROME-ALUMINUM ALLOY POWDERS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 10, Oct 84 (manuscript received 20 Apr 82) pp 50-52

BORISOV, Yu. S., ZOLOTOGOROV, M. G., Deceased, GORBATOV, I. N., KALINOVSKIY, V. R., PASHCHENKO, V. A., ZAYTSEVA, Z. A. and KOKORINA, N. N., Institute of Material Science Problems, Ukrainian Academy of Sciences

[Abstract] A study was made of the heat resistance, thermal stability and bond strength of atomized coatings of composite powders containing nichrome and an aluminum alloy with yttrium or lanthanum. It was found that introduction of 0.1% Y leads to formation of a well-developed subrain structure, facilitating the formation upon oxidation at 1000-1200°C of a finely dispersed scale resistant to thermal shock and having good adhesion to the base. The optimal content of binder and drying conditions were established. The optimal binder content was found to be 1.5-3%. Testing of thermal stability showed that the coatings containing rare earth metals began to break down significantly after 200 cycles, whereas coatings made of composite powders containing aluminum but no rare earth metals withstood not over 180 cycles. References 4: 1 Russian, 3 Western.
[76-6508]

UDC 669-494

EFFECT OF GEOMETRY OF FIBER PACKING ON CONSOLIDATION OF FIBROUS COMPOSITION MATERIALS WITH POROUS MATRIX

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 2, Mar-Apr 85 (manuscript received 30 Nov 83) pp 127-130

AREF'YEV, B. A., BONDARCHUK, L. A., PAVLOVA, T. I., RENNE, I. I. TIKHMYANOV, V. L. and USHAKOV, V. K., Moscow

[Abstract] Production of fibrous composition materials (FCM) by solid phase consolidation of a porous matrix is hampered by unevenness. The present article reports on analysis of the nature of such consolidation with a hexagonal packing with varying vertical and horizontal spacing. A mathematical model of a porous matrix and absolutely stiff fibers is presented. Results indicated that a hexagonal packing form with alpha = $\sqrt{3}$ was the best parameter for horizontal spacing of fibers. Reducing the initial porosity of the matrix made it possible to reduce irregularities in the density of the FCM material, especially where relative fiber content was very high. Figures 3; references: 1 Russian.
[179-12131]

UDC 621.762

CONDUCTIVITY OF METAL-CERAMIC MULTILAYER ZrO_2-Mo AND Mo-BASED COMPOSITE MATERIALS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 2, Feb 84 (manuscript received 9 Apr 84) pp 61-64

KATS, S. M., BYL'KOVA, Z. I., BOGIN, V. N., FILICHKIN, A. P. and CHUBENKO, N. G., Moscow

[Abstract] A study was made of the possibility of increasing heat conductivity of multilayer composites through the layers by replacing the purely oxide layers with cermets consisting of a homogeneous mixture of ZrO_2 and Mo. The specimens studied were disks 50 mm in diameter and 2 to 3 mm thick, sintered of stacks of plasticized sheet films produced from CaO-stabilized finely milled ZrO_2 powder (1-5 μm particle size) and Mo powder (1-10 μm particle size). The result showed that varying the content of the metal-ceramic phase can significantly alter heat conductivity from 20 to 100 W/m·k) while retaining the strength and thermal stability of oxide materials. Figures 3; references: 6 Russian.
[130-6508]

UDC 621.763.621.3.042

PRODUCTION OF MULTILAYER MAGNETIC SURFACE OF MAGNETICALLY SOFT COMPOSITE MATERIALS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 2, Feb 85 (manuscript received 28 Jun 83) pp 70-73

RITSO, A. E., KATRUS, O. A., LAANSOO, A. A. and SIYMAR, R. A., Tallin Polytechnical Institute

[Abstract] The direct rolling of powders is used to produce a substrate at least 0.4 mm thick capable of operating at high frequencies (up to 1000 Hz) and providing a magnetic induction of at least 0.9 Tl with reduced remagnetization losses with a field intensity of 5000 A/m. The ferromagnetic component used was iron powder, 99.2% Fe, 0.02 C, 0.01 Mn, 0.09 Si, 0.08 S, 0.01 P and 0.05 O_2, obtained by a chemical-metallurgical method. After rolling, the plates were heat-treated in air. The magnetically soft composite material with epoxy resin was treated at 160°C, the material with ethyl silicate at 550°C. Plates of minimum thickness and maximum density were obtained from the composite material with epoxy resin. The method of rolling produces substrates 0.35-0.4 mm thick with magnetic induction 1.02 and 1.35 Tl at 5000 and 10,000 A/m. In terms of magnetic characteristics, magnetic circuits of composite materials with silica differ little from circuits made of substrates with epoxy resin. Figures 3.
[130-6508]

UDC 534.282:621.002.3

CALCULATION OF DAMPING PROPERTIES OF COMPOSITE MATERIALS

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: CHERNAYA METALLURGIYA in Russian No 1, Jan 85 (manuscript received 30 Mar 84) pp 79-81

BRINZA, V. N., VEKSHIN, B. S. and KOLYADINA, Ye. V., Moscow Institute of Steels and Alloys

[Abstract] A study is made of the damping capability of a material consisting of a mixture of strengthening and plate-like granules exposed to a periodic load on its upper surface. It is assumed that granules do not slip relative to each other, that the deformation of the material by the periodic load is elastic and homogeneous, and that the periodic load acts on the specimen at a frequency significantly different from its resonant frequency. It is demonstrated that the method developed for calculation of damping properties of fiber composite materials can be applied to estimation of the damping properties of composite materials consisting of metallic granules. The variation in damping properties of the composite material as a function of relationship of elasticity modulus oscillation decrements, mass and density of the granule materials is obtained and experimentally confirmed. The method of calculation can be used to estimate the damping properties of other composite materials as well. Figures 1.
[125-6508]

THEORY OF PYROLYSIS OF COMPOSITE POLYMER MATERIALS

Novosibirsk FIZIKA GORENIYA I VZRYVA in Russian Vol 20, No 6, Nov-Dec 84 (manuscript received 24 Jun 83) pp 67-69

GRISHIN, A. M. and SINITSYN, S. P., Tomsk

[Abstract] The pyrolysis of composite polymers can be studied by studying the decomposition of the corresponding polymers. This article constructs a mathematical theory of the pyrolysis of composite polymers on the basis of simplified kinetic diagrams and representations of the mechanics of the reacting media. The direct and reverse problems of pyrolysis are formulated. The direct and reverse problems are analyzed under isothermal or homothermal conditions for one and two-staged kinetics of decomposition of the binder. A method is suggested for solving the reverse problems which has been tested on model examples. The influence of the error in experimental data on the solution of the reverse problem is demonstrated. The possibility is demonstrated on model to determine the thermokinetic constants of pyrolysis based on the results of experimental studies. Figures 6; references 14: 13 Russian, 1 Western. [100-6508]

CRITICAL BEHAVIOR OF THERMOELECTRIC POWER IN BINARY COMPOSITE MATERIALS

Moscow ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 88, No 2, Feb 85 (manuscript received 6 Jan 84) pp 516-521

SKAL, A. S., Institute of Engineering Physics imeni A. F. Ioffe, USSR Academy of Sciences

[Abstract] Thermoelectric power in binary random metal-metal or metal-insulator composites is considered, and its behavior as the hole concentration p_1 in the conducting component approaches the threshold of an infinite cluster is analyzed on the basis of site-problem and bond-problem models for phase transitions of the second kind. For calculation of the effective Seebeck coefficient in terms of the Peltier heat, its dependence on the properties of the two materials is evaluated for the two extreme cases of almost equal thermal conductivities ($k_1/k_2 \to 1$) and very different thermal conductivities ($k_1/k_2 \to \infty$). In the first case there are no active seats of thermal emf and the conducting component acts only as a shunt, while the second component in effect vanishes, In the second case electric charges and heat are conducted simultaneously when the carrier concentration is above the threshold level, with isothermal clusters breaking up fast within the critical range and the temperature of the infinite cluster tending to become a linear function of the carrier concentration. The author thanks Professor L. S. Stil'bans for discussion and very helpful comments, and the staff of the Computation Center at the Leningrad Institute of Nuclear Physics imeni B. P. Konstantinov for assistance in calculations and for the excellent software. Figures 2; references 13: 5 Russian, 8 Western. [148-2415]

UDC 534.28+532.135

TEMPERATURE-FREQUENCY VARIATION OF MECHANICAL LOSSES IN PERIODIC DEFORMATION OF MULTILAYER GLASS-REINFORCED PLASTICS

Novosibirsk ZHURNAL PRIKLADNOY MEKHANIKI I TEKHNICHESKOY FIZIKI in Russian
No 6, Nov-Dec 84 (manuscript received 14 Oct 83) pp 139-144

YELISTRATOVA, L. S., KOLOKOL'SHIKOV, V. V. and PODKOLAYEV, A. S., Kuybyshev

[Abstract] A study is made of regularities in the temperature-frequency position and magnitude of the maximum of loss angle tangent and real portion of Young's modulus in multilayer composites. The equations produced are illustrated with numerical computations of frequency-dependent elastic and damping characteristics of multilayer flass- and carbon fiber-reinforced composites in the area of transition of the matrix from vitreous to highly elastic states. Figures 5; references 18: 17 Russian, 1 Western.
[101-6508]

UDC 672.88:621.357:621.793.6

CORROSION RESISTANCE OF DIFFUSION AND GALVANIC COATINGS ON STEEL FASTENERS

Kiev TEKHNOLOGIYA I ORGANIZATSIYA PROIZVODSTVA in Russian No 4, Oct-Dec 84, p 43

SOLDATOV, B. F., SHAVLOVSKIY, Ye. N., KAPORIK, N. I., Engineers; BELITSKIY, M. Ye. and EPIK, A. P., Candidates of Technical Sciences

[Abstract] Studies were performed to determine the possibility and economic expediency of replacing galvanic coatings on steel fasteners with diffusion coatings which have similar corrosion resistance. Fasteners of type St. 3 steel with M4 thread 13 mm long were tested following diffusion chrome plating, chromo-aluminizing, aluminizing and zinc coating in powder mixtures consisting of the saturating element, an activator and a neutral diluting agent. Saturation was performed at 1223-1273°K (Cr, Al, Cr-Al) and 773-823°K (Zn) for $3.6 \cdot 10^3$-$1.44 \cdot 10^4$S. Thickness of the diffusion layers produced was 20-40 micrometers. In corrosion testing, corrosion occurred with all coatings in all corrosive media, diffusion coatings produced after chrome plating chromo-aluminizing being most corrosion resistant. Nickel and chrome galvanic coatings can be replaced with diffusion chromo-aluminized coatings on products that must meet certain esthetic requirements, or chromium diffusion coatings if esthetics are not as important.
[169-6508]

UDC 620-197

ANTICORROSION POLYMER PACKING FILM WITH IMPROVED PROTECTIVE PROPERTIES

Kiev TEKHNOLOGIYA I ORGANIZATSIYA PROIZVODSTVA in Russian No 4, Oct-Dec 84, pp 37-39

DOMANTSEVICH, N. I., KOPYL, O. N. and TYNNYY, A. N., Engineers

[Abstract] A new conservation and packaging material has been created, type IPP inhibited polymer film, which combines the processes of conservation and packaging of metal products while significantly improving conditions of labor.

IPP is a transparent polymer film based on low-intensity polyethylene modified during extrusion by the addition of a finely dispersed powder of dicyclohexylamine nitrite (DAN) corrosion inhibitor. Vacuum shrink wrapping of motor vehicle metal parts in the film is recommended. In this article, high-density polyethylene was used with hexamethyleneimine metanitrobenzoate as the corrosion inhibitor. This new film is superior to IPP in its protective properties, broad temperature interval at which it can be processed and relative cheapness. The quantity of inhibitor used in the new film is 0.25-2% by mass, or 0.25-2 g inhibitor per square meter of film 100 micrometers thick.
[169-6508]

UDC 535.721

EXTREMELY HIGH REFLECTIVE CAPABILITY OF ZIRCONIUM BURNING IN AIR UNDER EFFECTS OF CONSTANT CO_2 LASER RADIATION

Moscow IZVESTIYA AKADEMII NAUK SSSR: SERIYA FIZICHESKAYA in Russian Vol 49, No 4, Apr 85 pp 779-782

BUZYKIN, O. G., BURMISTROV, A. V., KOGAN, M. N., KONOV, V. I., PROKHOROV, A. M. and RAL'CHENKO, V. G., Institute of General Physics, USSR Academy of Sciences

[Abstract] During laser heating of metal in a gas medium, a common feature is a change in the metal's reflective capability. The present article reports on this mechanism in zirconium burned in air at atmospheric pressure with a constant CO_2 laser. While earlier studies had shown formation of Zr nitrides with deep slag as a layer between metal and oxide which did not harm relective capacity, the present article established that in the given nonisothermal process of laser combustion an oxynitride formed that completely determined reflection. Chemically polished plates .3 mm in thickness were irradiated in a photometric sphere at 20 watts, then cooled at $10^3 K.sec^{-1}$. Tests without tempering showed that at relatively low heating rates and final temperatures, reflective capability oscillated, indicating formation of slag the thickness of the radiating wavelength. X-ray analysis of yellow slag showed a cubic phase of ZrN_yO_z, which explained the flash of reflection during laser burning of zirconium. Two theories to explain the oxynitride position are suggested, the first based on the drop in partial oxygen pressure at the boundary between gas and oxide, and the second on a balancing of nitrogen and oxygen flows during the irradiation process. The first is given preference, and the oxynitride's effect as a determinant of relfective capability is discussed. Figures 3; references: 10 Russian.
[178-12131]

UDC 621.78.013.6:721.375.826:669.018.45

MECHANICAL LASER CUTTING OF METALS

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 2 Mar-Apr 85 (manuscript received 27 Sep 84) pp 4-7

GAVRYUSHENKO, B. S., OKOROKOV, L. V., RYKALIN, N. N., SMUROV, I. Yu., UGLOV, A. A. and KHALBOSHIN, A. P., Moscow

[Abstract] Processing properties of materials are often improved by supplemental heating of the zone being worked, commonly by electrical contact or plasma heating procedures. The advantages of laser heating are precise focus and localization, simplicity, maneuverability and stability. The present article reports on study of mechanical laser cutting procedures useing a device which is diagrammed and described. Positioning the transport mirror at a right angle to the power source permitted constant focus control at ca. 250 mcm from the cutting point. Cutting with laser heating was compared to cold cutting with analogous conditions. Instrument wear, power features of the cutting process and the quality of the final product were compared. Results indicated that at 1.0 KWT of power, the useful life of the cutting edge quadrupled, to 8 minutes. With lower force required for cutting, vibration was reduced. Hardening in the cutting zone was cut from 30 to 9% and its depth halved, and a much higher quality product resulted. Figures 5; references: 2 Russian.
[179-12131]

UDC 535.211

CERTAIN FEATURES OF LASER DESTRUCTION AND DISLOCATIONAL STRUCTURE OF SILICON DURING HEATING AND EFFECTS OF ELECTRICAL FIELD

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 2, Mar-Apr 85 (manuscript received 14 Jun 83) pp 37-40

BAKHAREV, M. S., GORBACHEV, A. A., MIRKIN, L. I., MOKH, A. S. and SHEVERDOVA, R. R., Frunze; Moscow

[Abstract] Silicon semiconductors are greatly affected by impurities. The present article reports on the effects of laser processing on silicon monocrystals, comparing properties before irradiation and after gamma-ray laser processing, polishing and annealing for 1.5 hours at 950°C in a vacuum oven. The GOR-100 laser's intensity was varied by focus adjustments. A nearly circular dense zone was found at the site of laser treatment. The dislocational changes in structure were the only variations noted before the melting point, despite the brittleness of pure silicon. After melting, an electrical current transmitted through the silicon resulted in arc-like cracks. Most damage was

to the surface. Structural distortions had a semispherical form with 1-2 mm diameter and 30-50 mcm depth. Temperature effects also were noted in the dislocational structure of the silicon samples. Figures 4; references: 3 Russian.
[179-12131]

UDC 621.373.826

STRUCTURE OF FLOW OF EROSION PLASMA FORMED UPON LASER TREATMENT OF METALS

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 3, Mar 85
(manuscript received 21 Aug 84) pp 639-640

MIN'KO, L. Ya., FEDYUSHIN, B. T., CHIVEL', Yu. A. and CHUMAKOV, A. N.,
Institute of Physics, Belorussian Academy of Sciences, Minsk

[Abstract] Special experiments showed that when metals are exposed to a laser beam the erosion plasma of the target material has a structured nature as does the flow of gas behind the subsonic radiation wave in air. The structure of the flow is observed both before and after development of shielding of the laser radiation. Flat specimens of aluminum, zinc and bismuth were exposed to a microsecond Nd laser beam with an energy of almost 40 J. The diameter of the irradiated spot was varied from 2 to 5 mm, varying the peak power between 10 and 600 MW/cm^2. A ruby laser beam with a pulse duration of about 30 ms and regulated delay was used to record shadow photographs of the flame produced. The structured nature of the air plasma and the flow of target material is obvious. The structure of the erosion plasma is thought to be purely kinetic in origin. The structure of the erosion plasma has dynamic rigidity and can be significant in the formation of the structured subsonic radiation wave in the stage of acceleration of the flame, when the heavy air plasma or air compressed by the shock wave breaks through into the lighter erosion plasma. Figures 2; references: 4 Russian.
[173-6508]

FERROUS METALLURGY

METAL INDUSTRY PLANS, PROBLEMS OUTLINED

Moscow PRAVDA in Russian 7 Mar 85 p 1

[Unattributed article: "Metal of the Five-Year Plan"]

[Text] The first quarter of this last year of the current five-year plan is coming to a close. The industry, including the metallurgists, is working hard to fulfill the plan and to meet their socialist obligations so as to honour the 17th Party Congress.

Ferrous metallurgy is rightly called the basic branch of the economy. The tasks facing the metallurgists during the current year are large and complex. The principal tasks are a fast increase of high quality, low cost production and the strict fulfillment of orders placed by machine building enterprises and other metal consumers.

If in 1983 the sector's plan fulfillment of finished products (taking into account fulfilled contractual obligations) represented 97.5 percent, then in 1984 it was 98 percent. Among the collectives of the metallurgical enterprises there are numerous conscientious, reliable suppliers. These are Zapadno-Sibirskiy, Novolipetskiy, Cherepovskiy, Makeyevskiy, Pervoural'skiy, Novotrubnyy and a number of others. Changeover to planning production of all rolled steel products in equivalent tons, by taking into consideration the volume of labour intensiveness involved for each type of product, has been completed. This made the production of all types of rolled steel, including the most economical ones more advantageous. A unified, computerized planning system could be used particularly for the follow up of orders placed to the metallurgists. At ten enterprises USSR Minchermet production and distribution units [Ministry for Ferrous Metallurgy] are united into manufacturing and distribution administrations.

But this is only the beginning. The management of the industry must be improved with more decisiveness. Production is often disrupted in metallurgical companies due to miscalculations in planning, interruptions in the supply of ore and materials and breakdowns at major units. Last year the metallurgists did not fulfill some of the plans for production of some essential goods. The national economy was short by more than two million tons of rolled steel and over three hundred tons steel tubing that was on order. This means that the ground lost must be recuperated with more determination, organization and order at each plant, each workshop must be strengthened so that as much as possible metal can be supplied that is needed by the national economy.

In this matter, the metallurgists are awaiting substantive aid from the supplying organs. As mentioned in PRAVDA, the specialists of the Kramatorskiy Metallurgical plant, the Cherepovetsk metallurgical combine, the Pervouralsk Novotrubnyiy plant and other enterprises, the central marketing directorates of the USSR Gossnab, are obligated to finish delivery of all orders at the beginning of each quarter. This is not the case in practice: orders are delivered with considerable delays and therefore the metallurgists cannot plan fulfillment of production orders in a precise fashion and cannot receive the necessary materials and semi-finished products.

The main direction for the development of the ferrous metallurgy, as recently stated at the CPSU Politburo Central Committee, is the modernization of the principal production capacities, the introduction of new techniques and processes. In particular it is important to produce as much steel as possible in converters and electrical furnaces, expand the utilization of continuous casting processes with its auxilliary processes, assimilate quickly the high productivity equipment, create the organizational as well as the economic premises for more efficient work, based on new and latest technologies.

Now, on the threshold of the 12th Five-Year Plan, particular attention must be given to the structure of capital investments in the ferrous metallurgy. Calculations show that advanced development of the rolling process and of the subsequent finishing processes have a two to threefold impact on the cost of developing capacities in the entire "ore to metal" metallurgical cycle. Quality improvements of the final product and expansion of the assortment, permit a reduction in the demand for additional metal production. This is very important since it is the increased growth rates of economical types of metal that must produce a 1.5 million ton savings of ferrous metals in the national economy as compared to 1984.

The machine builders expect the metallurgists to supply high quality material. There exists, however, a reverse connection as well. In order to obtain rolled steel and tubing in sufficient quantity, there is a need to increase the production capacities and to develop the machine building industry itself. At present, often many years pass from the conception of modern equipment to the time it is created, which forces the metallurgists to produce some type of equipment themselves, especially auxiliary equipment.

It should not be forgotten that nowadays economizing, including that of metal, is the most important source for guaranteeing production growth. In 1985 the national economy's additional requirements for rolled steel must be assured by almost 60 percent by rational utilization [of this resource]. A goal was set to reduce metal content in the national output by 1.6 percent. In order to solve this task successfully, an improvement of technical-economic indicators of the output production is required and unit losses of metal must be reduced. This especially concerns the machine building factories. It is enough to mention that more than half of the rolled steel is used by only 11 machine building ministries. And this year's plan calls for an accelerated development of the machine building industry. Therefore the metal content of machines and equipment must be reduced as must be consumption norms for rolled steel. The metallurgists must make a major effort to increase output of the most efficient types of products, so as to permit the manufacturing of light, durable structures.

The local party organizations are requested to increase demand upon management to rigorously fulfill their contractual obligations for the entire products list and to achieve a low cost, high quality output.

The socialist contest is widening and gathering strength under the slogan "More high quality metal for the Motherland!" The metallurgists of the country are determined to increase their output day by day and bring the same valuable contribution as the rest of the national economy to the successful accomplishment of this year's and the entire five-year plan's tasks.

12814
CSO: 1842/127

UDC 666.762.9

CERAMIC BASED ON ALUMINUM NITRIDE AND METALS

Moscow STEKLO I KERAMIKA in Russian No 2, Feb 85 pp 23-25

BUKHARIN, Ye. N., engineer, VLASOV, A. S., doctor of technical sciences, ALEKSEYEV, A. A., engineer, Moscow Institute of Chemical Technology imeni D. I. Mendeleyeva

[Abstract] A study is made to determine the possibility of producing metal-ceramics with service temperatures up to 1000°C. The cermets were obtained by sintering of binary mixtures of aluminum nitride powder with iron, nickel, chromium, molybdenum and tungsten. The gas medium used was a mixture of nitrogen with hydrogen, the nitrogen medium being more favorable for sintering of aluminum nitride, while hydrogen is necessary both for sintering of the metal powders and to reduce oxides which may be present. Aluminum nitride-metal compositions with 20-75% metal were studied. Components were prepared and mixed in a planetary mill. Specimens were shaped by semidry pressing at 20-25 kPa, then sintered in a periodic furnace in the nitrogen-hydrogen mixture. Near theoretical density was obtained in mixtures containing up to 50% iron and chromium, up to 42% nickel and up to 75% molybdenum and tungsten. Hardness of the composites decreases with increasing metal content and varies with hardness of the metal used. Composites containing iron, molybdenum and tungsten have good oxidation resistance at 800°C. Composites with nickel and chromium have significantly higher oxidation resistance at up to 1200°C (change in mass only 5 mg/cm^2 at 1200°C). Maximum oxidation of specimens containing iron, nickel and chromium at 1000°C occurs in the first 4 hours, while further holding at this temperature causes practically no additional mass change. Figures 4.
[123-6508]

UDC 621.74.5

INFLUENCE OF SODIUM ON MECHANICAL AND CASTING PROPERTIES OF MAGNESIUM-LITHIUM ALLOYS

Ordzhonikidze IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: TSVETNAYA METALLURGIYA in Russian No 6, Nov-Dec 84 (manuscript received 2 Dec 83) pp 79-83

NIKULIN, L. V., GAYEVSKIY, A. Ye. and DODROVA, L. K., Perm' Polytechnical Institute, Department of Production of Castings

[Abstract] A study was made of the influence of sodium on the mechanical properties yielded upon crystallization under pressure and the hot shortness of binary and more complex magnesium-lithium alloys. Binary alloys were prepared with lithium content corresponding to the α, α+β and β areas of the Mg-Li state diagram: 4.35, 7.3 and 11%. Multicomponent alloys were also produced with lithium content 4.73, 8.96 and 14.8% with 2.5% Zn, 0.5% Al, 0.3% Y and 0.2% Mn. The alloying elements were selected for their influence on strength and ductility of the binary magnesium-lithium base. Mechanical properties were tested on standard specimens cut from ingots 40 mm in diameter and 80 mm high-crystallized under piston pressure 200 MPa to eliminate shrinkage porosity. An increase in content of impurity sodium was found to decrease strength and particularly ductility equally whether specimens were crystallized under high pressure or solidified in a chill mold. β alloy is most sensitive to sodium contamination. The presence of sodium also significantly increases hot shortness. The sodium content should be not over 0.007-0.008% in α and α + β alloys, not over 0.002% in β alloys. Figures 2; references: 5 Russian. [105-6508]

DELAYS IN IMPLEMENTING POWDER METALLURGY CITED

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 27 Apr 85 p 2

[Article "From Powder to Part" by Yu. Dorofeyev, doctor of technical sciences, professor, head of the faculty of the Novocherkassk Polytechnical Institute, Novocherkassk]

[Text] The advantages of powder metallurgy have been proven in practice. This technology is revolutionizing industry, as was called for in last April's Plenum of the CPSU Central Committee. Take the example of "Rostsel'mash," where metal powders are used to produce about 1,500 of items of 20 different kinds annually. Most of these require miniumum subsequent processing, which has resulted in a three- to fourfold reduction in production manhours and a savings in rolled product of about 2,500 tons per year.

It would seem that these results speak for themselves. Then why is the scale on which this progressive technology is being implemented still far from desirable? Habitual references to the lack of powders are no longer valid today. In particular, the Sulinsk Metallurgical Plant in Rostov Oblast' is building and will soon start up a special shop with a design capacity of 80,000 tons of powder per year. But many specialists have considerable doubts: will there be a corresponding demand for this output?

The reasons for the delay in the dissemination of powder technology are typical for basic innovations which can be used in many industries. The matter is clearly established only at the scientific stage: the Scientific Council on Powder Metallurgy of the State Committee for Science and Technology coordinates prospective research and development. There is even a head research organization, the Institute for Problems of Materials Science of the Academy of sciences of the Ukraine. It is precisely to this institution that hundreds of representatives of industrial enterprises from various parts of the country come for recommendations and practical assistance in implementation.

We should not be surprised by this pilgrimage. The idea that part production requires only pressing powders and sintering them has apparently turned out to be overly simplified. Nor were hopes justified that, as precise processes were developed, every engineer would be capable of dealing with them. It has become clear that serious engineering analyses must precede implementation of powder metallurgy techniques.

By no means are all enterprises prepared to solve these problems on their own. There are even those who see no sense in studying them, since the parts they have to make from powders are of minor importance. Even if they are studying this subject, industry-sponsored production-oriented scientific research institutes do not have the capabilities to do engineering analyses for all their own enterprises.

All these problems have led to a search for the most effective way to organize work. For example, the plant in Brovary not only produces metal powders, but also produces parts made from them for its enterprise customers. About five percent of the powders are slated for conversion into finished parts at the Sulinsk Metallurgical Plant. With such concentrated manufacture, the net cost of parts can be reduced, and problems of assimilating new output become daily routine. There is only one "but"--the number of plants producing powders is small. Therefore, only a small group of enterprises can give them orders. Transporting small lots of parts over hundreds of kilometers is hardly justified.

From this standpoint, attempts to take advantage of production facilities concentrated at the regional level deserve closest scrutiny. We will say that the Tallin Production Amalgamation "RET" has organized production of parts from powders for a whole group of Republic enterprises subordinated to various authorities.

Basically, we are talking about regional interindustry production facilities. But the fact that they are based on enterprises with specific subordination raises many questions. For example, it is clear that this type of work arrangement will become widespread only if we find economic levers to make "work for your neighbor" advantageous to enterprises. There are dangers that enterprises will produce only those parts which are similar to their own.

Thus the increased interest in the powder metallurgy scientific production amalgamation created in Belorussia is understandable. Subordinate to the Council of Ministers of the Republic, it is, in the full sense, an interindustry regional center. Within its walls basic research is combined with engineering studies for specific enterprises which the amalgamation helps in assimilating advanced technology. A plant being built in Molodechno is slated to produce goods from powders for consumers who cannot economically organize their own production facilities.

It would seem that there is a great deal of sense in creating similar scientific production amalgamations in other regions, oblasts, and industrial centers as well. But this assumption immediately raises the question as to whom they are subordinated. Apparently the answer must be sought in the light of the task assigned by the Party--to increase the role of local councils. There is another approach: institutions of higher learning which have been gaining experience in powder metallurgy can serve as a base for creating profitable regional scientific production amalgamations. These institutions include our Novocherkassk Polytechnical Institute. But to carry out this proposal, the Ministry for Institutions of Higher Learning of the RSRFR must take an active stance.

The problem of creating scientific production amalgamations is directly related to the tasks of high schools: within their walls, future engineers could immediately acquire practical work habits. Lack of specialists is still delaying the development of powder metallurgy. Their training began only 4 years ago at institutions of higher learning in certain regions of the country. But the Northern Caucasus, where production of iron powders is now concentrated, seems to have been passed by. Attempts to correct this situation by the Rostov Party Obkom have been ignored by the Ministry for Institutions of Higher Learning of the RSFSR. But Ministry personnel know that our institute has gained experience unavailable to other institutions: in developing a theory and procedures for so-called dynamic hot pressing.

Research has shown that goods made from powders have low mechanical properties, primarily because of their increased porosity. To eliminate this porosity, several scientific collectives, including our Institute, proposed a technology for hot pressing porous powder blanks. It was implemented for the first time in the world at "Rostsel'mash" as early as 1975 and today produces 400 tons of items from those 1,500 tons that I spoke of earlier. The experience gained here is being used in COMECON countries. But, as paradoxical as it seems, the Sulinsk Metallurgical Plant apparently will not be able to use it in the near future: the automated line for producing finished pressed items will not start up as scheduled next year.

The consequences of failure to achieve this assignment are obvious: the line created should have become a model. This means that many enterprises will not receive equipment to produce items most important to them from powder in the near future. It may be that these consequences are of little concern to the Ministry for Ferrous Metallurgy of the USSR, which ordered the new line. But, from the standpoint of the user, it would be wise to think about problems involved in creating equipment for powder metallurgy.

It is quite clear that large enterprises and interindustry regional production facilities will require high-productivity equipment which can be easily rebuilt to produce new goods. But can it be built given the current organization of work? It is doubtful. Take, for example, the line for the Sulinsk Metallurgical Plant. The specification for the line was developed by "Giprostal'" at the Ministry for Ferrous Metallurgy of the USSR; the pressing area was assigned to the Special Design Bureau of the Ministry for the Machine Tool Industry, the furnaces to the Institute of the Ministry for the Electrical Engineering Industry. And so many cooks have spoiled the soup. As one might imagine, at this stage of work the Ministry for the Machine Tool Industry's system needs a head scientific production amalgamation which would be responsible for integrated development and production of equipment.

Nor can we ignore the problem of iron powder prices. Today they are three to five times more expensive than the corresponding rolled product. Therefore, a paradox frequently develops: a technology which sharply reduces labor costs and saves metal turns out to be unprofitable. Apparently, when powder prices were set, only the bureaucratic interests of the Ministry for Ferrous Metallurgy of the USSR were considered. Now, through the initiative of the

Scientific Council on Powder Metallurgy of the State Committee for Science and Technology, these prices have been somewhat reduced. But even their current level precludes the rapid improvement of powder production facilities that would radically reduce their net cost. Nevertheless, the prospects for the growth of powder metallurgy depend greatly on solving this problem.

12809
CSO: 1842/165

UDC 621.762.5

INTERACTION OF CUBIC BORON NITRIDE WITH TITANIUM IODIDES

Kiev POROSHKOVAYA METALLURGIYA in Russian No 10, Oct 84 (manuscript received 26 Sep 83) pp 57-59

VESNA, V. T. and MASLOV, V. P., Kiev

[Abstract] A thermodynamic analysis was presented of the reactions involved in the interaction of cubic boron nitride with a gas phase of titanium iodides. The equilibrium composition of the gas phase was computed in the 800-2000°K temperature interval. The phase composition of the reaction products was determined by x-ray diffraction studies. The results of the studies showed that the interaction between titanium iodides and cubic boron nitride becomes significant at 1000°K, forming titanium nitride up to 1100°K. At 1200°K a mixture of titanium mononitride and diboride is formed. The intensity of the diffraction lines of TiB_2 increases with increasing temperature, whereas increasing holding time from 0.25 to 2.0 hours does not lead to a great increase in TiB_2 reflex intensity. Figures 2; references: 8 Russian.
[76-6508]

UDC 533.9+536+669+295-162

THERMODYNAMIC ANALYSIS OF THE SYSTEM Ti-H-Ar IN HIGH TEMPERATURE AREA

Kiev POROSHKOVAYA METALLURGIYA in Russian No 10, Oct 84 (manuscript received 15 Sep 83) pp 59-62

GOROVOY, M. A., VENEDIKTOVA, L. A., and PRUTTSKOV, A. V., All-Union Scientific Research and Planning Institute of Titanium

[Abstract] A thermodynamic analysis is presented of the system Ti-H-Ar in the 1000-1900°K temperature interval. Equations are derived relating partial hydrogen pressure in the gas phase to hydrogen concentration in solution in titanium. The greatest change in composition of the solution occurs in the 100-1600°K interval, while at higher temperatures it depends little on either temperature or composition of the system. At 1800-1900°K, with atmospheric pressure of the gas phase, the same degree of hydrogen desorption occurs as at 100-1100°K and P = 10-100 Pa. Figures 1; references 7: 5 Russian, 2 Western.
[76-6508]

UDC 536.63

THERMOPHYSICAL PROPERTIES OF TUNGSTEN AT HIGH TEMPERATURES

Kiev POROSHKOVAYA METALLURGIYA in Russian No 10, Oct 84 (manuscript received 14 Aug 83) pp 72-75

SEMIN'KO, I. V., KRIVOROTENKO, A. D. and FOMICHEV, Ye. N. 'Metrologiya' Scientific-Production Association

[Abstract] In order to produce reliable values of the enthalpy and heat capacity of tungsten, these quantities were studied in the 1200-2800°K temperature interval. Based on the results presented in this work as well as studies performed at the Institute of High Temperatures, USSR Academy of Sciences, the author's production association in cooperation with the Institute has formulated a standard specimen of the thermodynamic properties of tungsten, which has been made a part of the State Register of Measures and Measurement Instruments of the the USSR, number 2458-82. References 16: 10 Russian, 6 Western.
[76-6508]

UDC 621.762.519.216.2:551.776

DETERMINATION OF POROSITY OF THIN SHEETS OF FIBER MATERIALS BASED ON OPTICAL TRANSMISSION COEFFICIENT

Kiev POROSHKOVAYA METALLURGIYA in Russian No 10, Oct 84 (manuscript received 24 Apr 84) pp 86-90

KOSTORNOV, A. G., KIRICHENKO, O. V., SAKHNO, S. P. and TYMCHIK, G. S., Institute of Material Science Problems, Ukrainian Academy of Sciences

[Abstract] An analysis is presented of the structure of porous fiber materials by methods of mathematical statistics and the theory of random processes. The interrelationship of porosity with optical transmission factor of fiber materials is studied within the framework of a single probabilistic-statistical approach. The fiber material models suggested allows structural parameters to be defined as statistical characteristics. Porosity and optical transmission factor of a sheet fiber material are defined with an error of not over 6% where porosity is over 70% as functions of the geometric dimensions of fibers, diameter d and length l, sheet thickness h and mean density of geometric fiber centers lambda. A function is established which allows porosity of thin sheets of fiber material to be determined by measuring optical transmission factor. Figures 4; references: 8 Russian.
[76-6508]

EFFECT OF HEATING CONDITIONS ON AGGLOMERATION OF POWDERED ALUMINUM IN AIR ATMOSPHERE

Novosibirsk FIZIKA GORENIYA I VZRYVA in Russian Vol 21, No 1, Jan-Feb 85 (manuscript received 9 Nov 83) pp 73-82

LIKENBAKH, A. K., ZAPORINA, N. A., KNIPELE, A. Z., STROD, V. V. and LEPIN', L, K., Riga

[Abstract] Much recent research has attempted to define the mechanism and quantify agglomeration and fusion of metals in precombustion and combustion. Factors such as the rate of temperature increase have been considered. The present article presents the results of electron microscope study of the effect of the heating rate on oxide layer breakdown of aluminum particles as related to structure and composition of the gaseous environment. A polydispersed aluminum powder with particle diameters averaging 10 mcm was deposited as a coating on corundum or nichrome, then subjected to temperatures of 1173-1473°K in a flow of air. The electron microscope images of the powder particles are described at temperatures in that range and heating rates of 2000 to 15,500°K/min agglomeration occurred without oxide layer breakdown. Thermomechanical reaction of the metal nuclei and the oxide layer and physicochemical oxidation of metals competed in the processes described. The initial state of the oxide layer and other important factors require further study. Figures 6; references 17: 13 Russian, 4 Western.
[142-12131]

UDC 621.762.5.001:539.4.42:620.18

SUPERELASTIC BEHAVIOR OF POWDERED TITANIUM NICKELIDE DURING PRESSING

Kiev POROSHKOVAYA METALLURGIYA in Russian No 2, Feb 85 (manuscript received 4 Apr 84) pp 13-17

MARTYNOVA, I. F., SKOROKHOD, V. V., SOLONIN, S. M. and FRIDMAN, G. R., Institute of Material Science Problems, Ukrainian Academy of Sciences

[Abstract] A detailed study is presented of the superelastic behavior of titanium nickelide powder during pressing. X-ray structural analysis was used to establish that at room temperature the TiNi phase with CsCl-type structure predominates in this material, corresponding to the high temperature state. This means that the point at which martensite conversion begins is below room temperature, so that the material should manifest its superplasticity at room temperature. Reversible deformation was studied during pressing of the material in a metallic pressed mold and heating of powder pressings. The volume of specimens with 50% porosity under load increased by 20-24% after the load was released over a period of 8 days. The increase in volume after pressing is thus multistaged, with significant volumetric growth immediately after load

relief followed by slight growth at room temperature and thermally activated expansion of the porous brickettes. The maximum degree of volume recovery does not reach 100%, decreasing with an increase in the degree of compacting of the material and increasing with increasing temperature up to 400°C and with increasing porosity. Repeated application of loads at the same pressure causes porosity to decrease over time. Figures 5; references: 7 Russian. [130-6508]

UDC 620.186.5:669.14.018.44

GRAIN GROWTH IN HEAT-RESISTANT AUSTENITIC STEEL

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 2, Feb 85, pp 54-56

DENISOVA, I. K., ZAKHAROV, V. N., KARPOVA, N. M. and FARBER, V. M., "Uralmash' Production Association

[Abstract] A study was made of the kinetics of grain grown in type 37Kh12N8G8 steel alloyed with V, Nb, Ti, Mo and W. The steel was produced in an arc furnace, ingots vacuum molded, subjected to homogenization annealing at 1050°C, 8 hr, and forged into 15 x 15 mm bars at 1180-900°C. Specimens cut from the bars were heated in a salt bath to 1150, 1200, or 1250°C, held 1.5 hours and quenched in water. It was found that the nature of the carbide phase and kinetics of its dissolution in heat-resistant austenitic steels define the tendency of the steel toward grain growth. A decrease in diffusion mobility of atoms in the steel matrix caused by alloying with titanium and tungsten leads to significant decreases in the tendency toward grain growth and grain size variation. Figures 3; references: 5 Russian.

UDC 669.187.2:669.046.52.001.5

ELECTRIC SLAG REMELTING OF HIGH STRENGTH STRUCTURAL STEEL TYPE 12GN2MFAYu (VS-1) UNDER FLUX CONTAINING RARE EARTH METAL COMPOUNDS

Kiev PROBLEMY SPETSIAL'NOY ELEKTROMETALLURGII in Russian No 1, Jan-Mar 85 (manuscript received 4 May 83) pp 5-7

PATON, B. Ye., MEDOVAR, B. I., TIKHONOV, V. A., SAYENKO, V. Ya., PAKHURIDZE, V. N., GLADSHTEYN, L. I. and GAVRILENKO, L. G., Institute of Electric Welding imeni Ye. O. Paton, Ukrainian Academy of Sciences, Kiev; Central Scientific Research Institute for Planning of Steel Structures, Moscow

[Abstract] Type VS-1 induction melted steel was subjected to electric slag remelting. Type ANF-32 flux was used, as well as experimental fluxes containing rare earth metal oxides and fluorides. The REM oxides or fluorides were introduced to the surface of the ANF-32 flux, preliminarily melted in a graphite crucible. Addition of the REM compounds did not influence the electric conditions of remelting. The content of major alloying elements also remained unchanged after remelting. A tendency was noted toward decreasing loss of aluminum and increasing loss of silicon. Oxygen content dropped from 0.007%

in the initial metal to 0.004-0.005% in the electric slag remelting under fluxes containing REM compounds was 80 to 90% higher than that of the initial metal, 20 to 25% higher than that of metal remelted under ANF-32 flux. Figures 1; references 5: 3 Russian, 2 Western.
[122-5408]

UDC 539.4

EFFECT OF ELASTOPLASTIC CYCLIC DEFORMATION ON MECHANICAL CHARACTERISTICS OF STEEL 03Kh13AG19 AT TEMPERATURES OF 293 AND 77°K

Kiev PROBLEMY PROCHNOSTI in Russian No 4, Apr 85 (manuscript received 10 May 84) pp 36-39

STRIZHALO, V. A., MEDVED', I. I., SUPTELYA, V. V. and DEMIDENKO, L. N., Institute of Problems of Strength, UkSSR Academy of Sciences, Kiev; Kommunarsk Mining and Metallurgy Institute, Kommunarsk

[Abstract] Unstable mechanical loads may occur as short-term overloads that reach or exceed the yield point of given construction materials. The present article reports on study of the effects of deformation under such overloads on durability and plasticity of alloys made by cryogenic technology. Cyclic loading and subsequent failure were determined for cylindrical samples of 03Kh13AG19 steel with an electromechanical device adapted to place controlled loads and maintain the temperatures of 273 and 77°K. Since low-temperature tensoresistors were impractical under the given parameters, special extensometers and clock-type indicators were substituted. Results indicated that significant changes occurred in the deformation diagram, particularly in the zone of elastic-to-plastic transition. Preliminary elastoplastic deformation reduced the material's ability to endure deformation strengthening and increased the likelihood of brittle failure. Temperature reduction had no qualitative effect. Figures 3; references: 6 Russian.
[168-12131]

UDC 669.15-194:669.74-131.4-156-156:620.17:620.18

SPECIFICS OF THE PROCESS OF FAILURE OF STRUCTURAL STEELS STRENGTHENED BY THERMOMECHANICAL WORKING WITH DEFORMATION IN THE INTERCRITICAL TEMPERATURE INTERVAL

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: CHERNAYA METALLURGIYA in Russian No 1, Jan 85 (manuscript received 3 Aug 84) pp 85-90

BERNSHTEYN, M. L., ODESKIY, P. D., GRYUNVAL'D, T. M., Moscow Institute of Steels and Alloys

[Abstract] A study is made of the specifics of failure of rolled materials after hardening working by thermomechanical treatment with deformation in the intercritical temperature interval and subsequent high tempering, achieving a

tensile strength of at least 500 MPa with exceptional cold shortness. The study was performed on type 15G2SF steel, composition: 0.16% C, 1.45% Mn, 0.60% Si, 0.09% V, 0.006% S, 0.016% P. Treatment consisted of austenitization at 930°C for 20 minutes with subsequent cooling to the temperature of the middle of the intercrystalline interval and holding at this temperature for one hour with subsequent deformation by rolling with 50% compression in one pass. Studies were performed on nontempered specimens and also after low- and high-temperature tempering at 250 and 650°C for one hour. The excellent cold shortness is found to be provided by creation of a specific substructure consisting of large subgrains within which there are much smaller subgrains and by the presence of "splits." The specific substructures result from dynamic recrystallization in place, the "split" from the strong texture formed in thermomechanical treatment. Figures 4.
[125-6508]

UDC 621.791.052:620.17

MECHANICAL PROPERTIES OF EP794 STEEL + 12Kh18N10T STEEL BIMETAL

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 4, Apr 85, pp 18-19

BORISENKO, V. A., candidate of technical sciences, DENYACHENKO, O. A., candidate of technical sciences and PARFENOV, M. G., engineer, Severodonets Branch, Ukrainian Scientific Research Institute of Chemical Machine Building

[Abstract] A study is made of the mechanical properties and structure of a bimetal obtained by explosive welding of a cladding layer of EP794 steel 11 mm thick to a base layer of 12Kh18N10T steel 20 mm thick. Specimens were tested in the initial state and after various types of heat treatment including tempering, annealing and hardening. The joint was a wavy boundary with deformed, smaller grains on both sides. Melted areas had a characteristic column structure with shrinkage cracks in some inclusions. Annealing at 850°C caused recrystallization and coagulation of the carbide phase. Hardening from 1050°C results in the formation of carbides along the deformation texture at the grain boundaries. The bimetal has optimal mechanical properties in its initial state and after hardening. Heat treatment may be required after welding, forging, etc. Figures 2; references: 2 Russian.
[163-6508]

UDC 669.14:620.184.6

MACRO- AND MICROFRACTOGRAPHIC SPECIFICS OF DISSIPATED IMPACT RUPTURE OF TYPE 45 STEEL IN THE VISCOUS-BRITTLE TRANSITION INTERVAL

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 2, Feb 85, pp 27-29

BOTVINA, L. R. and KLEVTSOV, G. V., Institute of Metallurgy imeni A. A. Baykov, Frunze Polytechnical Institute

[Abstract] A study was made of the specifics of dissipated rupture at the viscous-brittle transition temperature interval of type 45 steel with a microstructure after annealing at 900°C consisting of alternating areas of ferrite and perlite, the apparent cause of its dissipated failure. Impact testing of prismatic specimens with V-shaped stress concentrator was conducted on a swinging hammer at temperatures from 180°C to -196°C, with quantitative macrofractographic analysis performed on an optical microscope and comparator, microfractographic analysis performed on a type JSM-U3 scanning microscope. X-ray structural analysis of the state of the materials near the fracture surfaces in their central portion was performed on an x-ray diffractometer in cobalt K_α radiation. The studies allowed tracing of the regularities of dissipated fracture in the viscous-brittle transition interval of temperatures. At temperatures of 130°C the entire fracture had a fibrous structure. At 90-130°C dissipated failure occurred, with areas of viscous and brittle fracture in the center of the fracture. At 90 to -196°C the fracture is entirely brittle, with a zone of stable crack growth seen in microfractographic analysis at the tip of the notch, indicating that the fracture is concentrated. Figures 3; references: 5 Russian.
[107-6508]

UDC 620.178.162

DURABILITY OF STEEL 45 WITH BORIDE COATING IN CORROSIVE-ABRASIVE MEDIA

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 21, No 2, Mar-Apr 85 (manuscript received 27 Dec 83) pp 118-120

KOZUB, V. V., GOLUBETS, V. M. and PASHECHKO, M. I., Physico-Mechanical Institute imeni G. V. Karpenko, UkSSR Academy of Sciences, Lvov

[Abstract] The present article reports on study of the effect of a corrosive-abrasive medium on the durability of steel 45 with a boride coating. Samples were tested under roller-bushing conditions at relative creep rates of 0.4, 0.6 and 0.8 m/sec, pressure of 1-5 MPa and 30 minutes duration. Introduction of KOH or HCl gave pH ranging from 12 to 1. Results showed that with 2-3 MPa load durability increased, while with higher pressure it decreased. The friction surfaces showed microscratches and bright worn spots after creep. In

further testing the pores of the boride coating were additionally plated with nickel to prevent corrosion. Wear increased thereafter in correlation to pressure. Corrosive-abrasive media were judged to reduce surface hardness and thus cause accelerated wear in steel 45. Values of 7.4 and 12 pH were not accompanied by changes in the boride coating's properties. Figures 3; references: 5 Russian.
[174-12131]

UDC 620.193.918:669.15'24'28'25

DISPERSION HARDENING OF HIGH-STRENGTH Ni-Co-Mo STEELS

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 5, May 85 pp 33-37

RAKHSHTADT, A. G., KAN, A. V., KHOVOVA, O. M., PERKAS, M. D. and YEDNERAL, A. F., Moscow Order of Lenin and Order of Red Banner of Higher Labor Technical School imeni N. E. Bauman; Central Order of Red Banner of Labor Scientific Research Institute for Ferrous Metallurgy imeni I. P. Bardin

[Abstract] Secondary hardening with emission of special carbides and formation of alloyed martensite is accompanied by a sharp brittle change, which can be partially avoided by careful choice of alloying components. The present study considers the system Fe-Ni-Mo, in which the Fe-Ni martensite matrix undergoes less embrittlement and less carbon content is found. Molybdenum is the agent causing the secondary hardening. The carbide formed dissolved in austenite starting at 1000°C, the alloy retaining plasticity and viscosity. The test steel, which contained 0.3% carbon, was alloyed with 6% molybdenum and, in various samples, 5, 10 and 15% Co. Results showed that at 1100-1150°C, there was sufficient dissolution of excess phases with preservation of the fine-grain structure. After tempering at 1150°C up to 25% residual austenite remained; processing in liquid nitrogen reduced that percentage. Mechanical tests showed that the Fe-Ni martensite retained high plasticity with increased durability. The alloy contained a high degree of saturated alpha-solid solution, thus facilitating its use as a matrix phase for supplemental tempering. Optimum cobalt content was 10%. Figures 2; references: 6 Russian.
[175-12131]

UDC 621.74.073

MODELING OF THERMAL FATIGUE AND EROSION OF COMPLEX ALLOYED STEELS IN METAL MELTS

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 20, No 6, Nov-Dec 84 (manuscript received 20 Jun 83) pp 12-15

GLUKHOV, Yu. A., ABRAMOV, A. D., Vologod Polytechnical Institute

[Abstract] Several possible programs are presented which can be used for structural elements cyclically interacting with metal melts for experimental estimation of the corrosion durability of structural elements used in liquid metals. A schematic plan of erosion is studied, including fatigue damage to the element cyclically interacting with the melt, the accumulation of fatigue damage in the surface layers of the structural element being determined by the entire complex of adsorption-diffusion effects, chemical and hydrodynamic desorption in the process of repeated cyclical loading of the cross section by contact with the liquid metal. As an example of implementation of the approach suggested, conditions of testing of hollow circular and smooth continuous specimens in torsion in a melt are analyzed. It was found that the durability of steels under the test condition reaches a maximum at quite different hardening temperatures. Erosion on a base of 15,000 cycles is minimal in the interval of very high hardening temperatures, 1370-1420°K. Nitriding and cyaniding of type 4Kh5MFS steel were studied for their influence on erosion resistance in liquid metals. It was found that at less than 2000 cycles the rate of erosion of treated specimens was less than structurally homogeneous specimens. It then increased rapidly, so that at 3000 cycles due to the development of a system of fatigue cracks erosion of the metal from the surface was much more rapid than for untreated metals. Figures 4; references: 2 Russian.
[86-6508]

UDC 669.15:539.43:621.039.5

STUDY OF EFFECT OF NORMAL REACTOR WATER ON GROWTH RATE OF FATIGUE CRACKS IN 15Kh2NMFA STEEL

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 21, No 2, Mar-Apr 85 (manuscript received 25 Oct 83) pp 32-34

POKHMURSKIY, V. I., ZUBCHENKO, A. S., POPOV, A. A., GNYP, I. P., TIMONIN, V. M., DUTSIAK, I. Z. and ANTOSHCHAK, I. N., Physico-Mechanical Institute imeni G. V. Karpenko, UkSSR Academy of Sciences, Lvov

[Abstract] High temperature water reduces steel's durability; this factor has recently received more attention by engineers working with pressure systems. To test the steel under conditions approaching normal use, a laboratory autoclave was designed to test pressures up to 18 MPa at water temperature of

350°C. The growth of fatigue cracks was measured in compact samples of 25 mm thickness during thermal processing. The device made it possible to replicate a symmetrical triangular loading pattern; loads were applied in a range of 6.8-11 mHz, with constant temperature control in a sealed chamber. The relationship between the kinetic diagram of fatigue failure and the rate of fatigue crack growth is discussed. Results showed less fatigue cracking at lower coefficients of stress intensity, and a correlation as that coefficient and the rate of cracking increased. Further refinement of the methods used is recommended. References 22: 13 Russian, 9 Western.
[174-12131]

SUPERHARD MATERIALS DEVELOPED

Minsk SOVETSKAYA BELORUSSIYA in Russian 14 Jun 85 p 2

[Article by V. Bibikov]

[Excerpt] Scientists of the Belorussian Academy of Sciences' Institute of Solid-State and Semiconductor Physics have developed two new superhard materials. Their properties surpass those of their previous counterparts by a substantial measure.

The first innovation comes in the form of round black 'tablets' for making cutters, reamers and other metalworking tools.

The new tools can operate continuously for 4-6 hours. This is 4-6 times as long as tools made of superhard cubic boron nitride, which was developed at the same institute.

"The new superhard material for metalworking tools," explained member of the Belorussian Academy of Sciences B. V. Boyko, the institute's director, "is but one of the examples which graphically illustrate the possibilities of modern technology based on the utilization of high pressures and temperatures. At our institute, original equipment which can develop ultrahigh pressures at a temperature of more than 3,000 degrees has been developed."

Large specimens of cubic boron nitride were first synthesized without the aid of a catalyst by Belorussian scientists in 1970. Subsequently, the Belorussian scientists improved the cutting characteristics of polycrystals based on cubic boron nitride by 50-100 percent. By adding

certain components to the source material, the characteristics of the resulting superhard material could be controlled.

And now the latest accomplishment -- the new cutting tools, which are only slightly less hard than diamond, are, unlike diamond, not affected by high temperatures and do not react chemically with iron, cast iron and steel. In comparison with the previously best superhard material "belbor", which was also developed by Belorussian scientists, and with its foreign counterparts, the innovation is 2-3 times as wear resistant and is better able to withstand shock loads.

"The new tools are most effective in the machining of parts made of ferrous metals and hard alloys, which are becoming ever more widely used in industry," said Doctor of Technical Sciences A. M. Mazurenko, head of the laboratory for synthesis of superhard materials and one of the authors of the new development.

The second superhard material developed under the direction of A. M. Mazurenko equals natural diamond in hardness at only a fraction of its cost. It will be used in bits for drilling deep and superdeep boreholes as well as in tools for machining nonferrous metals. In the latter case, the surface of the part becomes almost as smooth as a surface that has been polished.

FTD/SNAP
CSO: 1842/188

MICROMECHANISMS OF ELECTRODIFFUSION FAILURES IN THIN FILM METALLIZATION

Leningrad ZHURNAL TEKHNICHEKSOY FIZIKI in Russian Vol 55, No 2, Feb 85
(manuscript received 20 Apr 84) pp 348-353

SOLOV'YEV, V. N., SINKEVICH, V. F. and DYADYNA, G. A., Krivoy Rog State Pedagogic Institute

[Abstract] A microscopic approach is suggested for the construction of models explaining the kinetic properties resulting from the influence of grain boundaries in which without concrete specification of the model of the polycrystal it is possible to produce activation characteristics of a film. The reasons for non-zero divergence of the ion stream are investigated. Processes of particle transfer in disordered media are studied and the influence of dimensional effects of the electric transfer of ions in thin films is discussed. This literature analysis indicates that the activation energy of migration of Al in polycrystalline films varies between 0.3 and 1.2 eV as a function of the structure of the grain and method of production of the film. E_α varies greatly as a function of the structural irregularities in the films. In textured films as well as films with 'bamboo' structure, transfer processes are essentially blocked. Introduction of impurities such as Cu, O_2, Mg and Si to films slows the processes of electrodiffusion. Diffusion of amorphous films, particularly at high temperatures, leads to slowing of electrotransfer processes. Figures 3; references 9: 6 Russian, 3 Western.
[136-6508]

UDC 621.785.532.062.57

ION NITRIDING OF TITANIUM

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY MV I SSO SSR: MASHINOSTROYENIYE in Russian No 5 May 85 pp 107-110

[Translation of an article Issledovaniye ionnogo azotirovaniya titana by D. A. Proshkin, doctor of technical sciences, T. A. Panayoti, candidate of technical sciences, G. V. Solov'yev, engineer]

[Abstract] The effect of various ion nitriding process factors (temperature, duration, pressure, composition of the gaseous medium) on the structure, phase composition, and properties of diffusion layers is studied.

It is shown that nitrogen pressure in the chamber has a significant effect on diffusion zone thickness, a relationship which has an extreme nature and that a nitrided titanium layer of greatest thickness can be achieved in a mixture of nitrogen diluted with argon. It is established that an adequate diffusion layer depth can be attained in titanium VT1-0 with short holding periods and relatively low temperatures. Ion nitriding increases the wear resistance of titanium VT1-0.

The effectiveness of using a glow discharge to accelerate the process of gas nitriding titanium is established.

[Text] Improving the qualitative indices of materials makes it possible to reduce metal use in machines and mechanisms while improving their performance. One such material is titanium, which has several valuable properties: low specific gravity, corrosion resistance, high specific strength. However, it has low antifriction properties. A common method of surface-hardening titanium, which increases its wear resistance, is gas nitriding. Existing methods of nitriding titanium in various nitrogen-containing gas media involve rather lengthy processing [1]. One way to accelerate the gas nitriding process is to carry it out in a glow discharge.

The purpose of this article is to study the effect of various ion nitriding process factors (temperature, duration, pressure, gas medium composition) on the structure, phase composition, and properties of the diffusion layer.

The material studied was commercially pure titanium VT1-0 with an alpha-structure. Impurity content satisfied OST 1.90013-71. Nitrogen and argon were mixed with a gas mixer in proportions required for the experiment.

After ion nitriding at a temperature below the polymorphous transformation point, microsections (after appropriate pickling below the thin nitride layer) exhibit a zone which is an alpha-solid solution of nitrogen in titanium. Microhardness values for this zone directly below the nitride layer are H_{50} = 1,500 and gradually drop to base microhardness (H_{50} = 200). No phase boundaries were observed between the nitrided zone and the base. Another picture was evident after nitriding at temperatures above polymorphous transformation. Below the outer nitride layer there was a light band with a microhardness of H_{50} = 1,500-600, whose thickness is a function of the temperature and length of the process and reaches values higher than those after ion nitriding at 850°C. Below this is a nitrided zone whose microhardness gradually decreases to base level. After processing at these temperatures, a clear phase boundary was observed between these layers. Obviously, there is an alpha-solid solution directly beneath the nitride layer, and below this layer there is an alpha-solid solution which has undergone polymorphous transformation from a beta-solid solution during cooling at process temperature. The phase boundary is fixed, since the structures of the alpha-phase which results from the breakdown of the beta-phase during cooling and of the alpha-phase which has not undergone phase transformation are different.

X-rays taken of the surface of the titanium VT1-0 nitrided at temperatures both below and above the polymorphous transformation point exhibit interference lines from the family of three-phase crystal planes: TiN with face-centered cubic lattice (beta-phase), Ti_3N with tetragonal lattice (epsilon-phase), and a solid solution of nitrogen in titanium with hexagonal close-packed lattice (alpha-phase). Parameters for the crystal lattices of nitrides of beta-TiN, epsilon-phase (Ti_3N), and the alpha-solid solution correlate with published data [2]. After ion nitriding below 850°C the intensity of the x-ray lines from the crystallographic planes corresponding to the epsilon-phase was lower and that of the beta-phase higher, than after processing at 900°C and above.

Thus a mononitride of TiN and a nitride of Ti_3N form on the surface of the nitrided titanium VT1-0, below which lies an alpha-solid solution at whose boundaries nitrogen concentration corresponds to that of the alpha-phase homogeneity region at saturation temperature. The sequence of phase formation during ion nitriding of titanium corresponds to the general mechanism of diffusion layer formation during chemical/heat-treating [3], i.e., it is qualitatively defined by the sequence in which they lie along the isothermic horizontal on the titanium-nitrogen constitution diagram.

The kinetics of the ion nitriding of titanium VT1-0 were evaluated in terms of layer thickness in microdurometer tests.

Figure 1. Diffusion zone thickness as a function of the duration of the titanium VT1-0 ion nitriding process at 0.8 GPa pressure and temperatures: (1) 850°C; (2) 900°C; (3) 950°C; (4) 1,000°C.

Key: (a) X, microns; (b) time, hr.

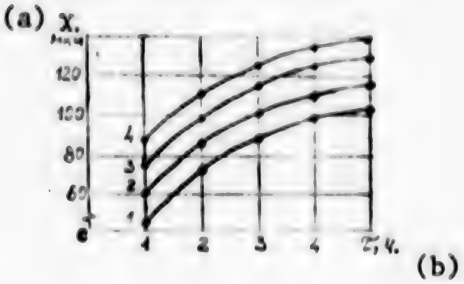

Figure 1 shows total nitrided layer thickness as a function of the duration of the ion nitriding process at different temperatures. As process time increases, layer thickness grows and the time-dependence of the nitrided layer varies parabolically. Nitriding kinetics in this case can be described by the equation:

$$X = Kt^n, \quad (1)$$

where X is the thickness of the nitrided layer, t is the duration of the ion nitriding process; K, n are constants. The values calculated for exponent "n" at 800-1,000°C were about 0.5. Therefore we derive:

$$X^2 = K_0 t. \quad (2)$$

This satisfies the general principles of diffusion and indicates that the factor which controls the ion nitriding of titanium VT1-0 is nitrogen diffusion.

The effect of temperature on diffusion in titanium VT1-0 was studied at temperatures from 800 to 1,000°C. Processing data in the polyorthographic coordinates "$\lg X^{-1}/T$" showed that the temperature-dependence of layer thickness in the case of ion nitriding of titanium VT1-0 is subject to an exponential function [4]. The value calculated for the energy at which nitrogen diffusion in the titanium is activated at 900-1,000°C is 142.8 kJ/mole.

Study of the effect of temperature on the ion nitriding process showed that sufficiently deep diffusion can be achieved with short holding periods and relatively low temperatures. Thus, ion nitriding makes it possible to shorten the process of surface-hardening titanium by a factor of more than 15. At temperatures above 900°C, considerable grain growth causes noticeable deterioration in the material's mechanical properties.

Figure 2 presents diffusion zone thickness as a function of nitrogen pressure in the unit's working chamber. Nitrogen pressure has a significant effect on diffusion zone thickness. Maximum thickness occurs after ion nitriding at a pressure 0.8 GPa. A change in pressure as compared with this figure reduces the thickness of the nitrided layer. The function (cf. Figure 2) is extreme in nature. The existence of a maximum is attributable to the general mechanisms of nitriding in a glow discharge. If pressure increases, a large number of active nitrogen ions which can take part in nitriding forms. However, if the number of nitrogen ions increases, their kinetic energy decreases because

of a reduction in free-path length as a result of collision, and, consequently, the number of diffusing nitrogen atoms decreases. Therefore there is a specific nitrogen pressure at which maximum nitrogen ion diffusion mobility and, consequently, maximum diffusion zone thickness, is ensured.

Figure 3 shows diffusion zone thickness as a function of gas medium composition. The greatest diffusion zone thickness occurs during nitriding in a mixture containing 0.05% N_2 + 99.95% A_r. This is because, during nitriding in a mixture of argon and nitrogen, the activity of the nitrogen increases since adsorption of molecular nitrogen on the metal's surface decreases, which increases the content of active ions involved in diffusion on the metal's surface.

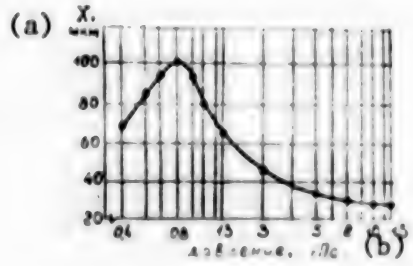

Figure 2. Diffusion zone thickness as a function of nitrogen pressure in the working chamber at ion nitriding temperature of 900°C and process time of 3 hr.
Key: (a) X, microns; (b) Pressure, MPa.

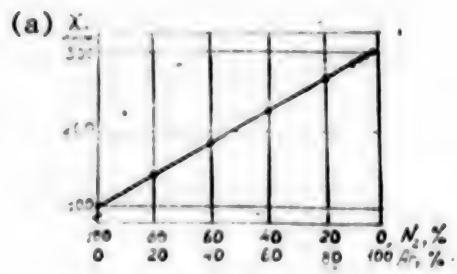

Figure 3. The effect of gas medium on the thickness of the titanium VT1-0 diffusion zone at ion nitriding temperature of 900°C, pressure of 0.8 GPA pressure and process time of 3 hr.
Key: (a) X, microns.

Thus, ion nitriding of titanium is best done in a gaseous mixture of nitrogen and argon.

Wear resistance of titanium VT1-0 was evaluated on a Shkod-Savin machine at a 100-N load. The reference was a sample of tempered steel U10 with a hardness of 60-62 HRC. The wear resistance of titanium VT1-0 nitrided in undiluted nitrogen increased by a factor of 1.5. Wear resistance after nitriding in a mixture of nitrogen and argon increases by a factor of 3.3-4.0 under similar conditions. This increase in wear resistance results from the formation of a thick, solid, nitrided layer on the surface.

The research conducted demonstrates the effectiveness of using a glow discharge to accelerate the gas nitriding process.

BIBLIOGRAPHY

1. Kiparisov, S. S., Levinskiy, Yu. V., "Azotirovanie tugoplavkikh metallov" [Nitriding Heat-Resistant Metals], "Metallurgiya" Press, Moscow, 1972.

2. Gol'dshmidt, Kh. Dzh., "Splavy vnedreniya" [Interstitial Alloys], translation from English, "Mir" Press, Moscow, 1971.

3. Prokoshkin, D. A., :Diffusion of elements in solid iron," in the anthology "Khimicheskiye i termicheskiye metody obrabotki stali" [Chemical and Termal Methods for Processing Steel], Metallurgizdat, Moscow, 1938.

4. Vasil'yeva, Ye. V., Voronova, T. A., "Determining Diffusion Activation Energy in a Chemical- and Heat-Treating Process," Izvestiya vuzov. Mashinostroyeniye, 1979, No 6.

12809
CSO: 1842/176

UDC 669.295:539.56

CALCULATION OF FAILURE CONSTANT FOR TITANIUM ALLOYS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 2, Mar-Apr 85
(manuscript received 6 Dec 83) pp 154-156

BOCHVAR, A. G., Moscow

[Abstract] In recent times titanium alloys have received wide application in industry for construction and heat-resistant materials. Their use is projected on the basis of calculations of displacement and shearing failure parameters. The "delta" parameter has been suggested for such calculations, and its application to pure, industrial and mass-produced titanium is presented in the present article. Data are presented that show that for iron and alloys based on it, the delta parameter or constant of failure depends little on the chemical composition of the alloy. Rather, a correlation is found between changes in the thermal content of the metal during heating up to the melting point. The relationship between the displacement module and the Jung module was found to be important as temperature increased, but the former has not always been determined in related experiments. Results indicated that the previously suggested value of 0.12 for the delta parameter of titanium alloys is generally applicable for engineering calculations. Figures 2; references: 6 Russian.
[164-12131]

UDC 620.194:669.295.5

SUBCRITICAL CRACK DEVELOPMENT UNDER CONSTANT LOAD IN VT6 ALLOY

Kiev POROSHKOVAYA METALLURGIYA in Russian No 4, Apr 85 (manuscript received 28 Feb 83) pp 74-79

FISHGOYT, A. V., KOLACHEV, B. A. and GRINBERG, V. A., Moscow Institute of Aviation Technology

[Abstract] Cracking of titanium alloys under constant loads limits their use in construction. The present article reports on study of the nature of this cracking using VT6 alloy with 6.0% Al and 4.5% V forged in the beta zone with minor deformation in the alpha + beta zone and retaining a platelet structure. Samples 125 x 120 x 50 mm were cut, and either immediately annealed at 1023°K or hydrogenated before that annealing. Part of the hydrogenated samples were placed under load by insertion of a wedge in a slit for 3 months. The coefficient of stress intensity was measured at the beginning and end of the tests, and the development of the slit was determined microscopically and by ultrasound methods. Results indicated that subcritical cracking was found only in materials subjected to plane deformation. A model relating elements sensitive

to deformation to the coefficiency of stress intensity (CSI) was formulated to show the correlation between cracking sites and growth in the CSI. The linear nature of this phenomenon and its connection with hydrogen damage is shown mathematically. As hydrogen diffuses in the crack surface, where great expansion tension is present, a continuing cracking process takes place. A catastrophic decline in impact resistance occurs in the VT6 alloy when hydrogen concentration reaches 0.12% of weight. Figures 5; references 6: 5 Russian, 1 Western.
[168-12131]

UDC 539.3:621.793

SILICIDE COATINGS FOR PROTECTING TITANIUM-NIOBIUM ALLOYS FROM HIGH-TEMPERATURE OXIDATION

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 2, Mar-Apr 85 (manuscript received 24 Sep 84) pp 96-98

LAZAREV, E. M. and KORNILOVA, Z. I., Moscow

[Abstract] Titanium-niobium alloys have high durability, corrosion resistance, and heat durability, but low wear values and a tendency to stick. The present article reports on study of silicide coatings with a surface film of nearly pure SiO_2. Heat resistance of the test material was studied at 1100°C in alloys with 30-50% niobium, showing severe oxidation and formation of slag after 15 hours. The alloys were then coated with silicide by solid-phase diffusion. Electronographic and x-ray study showed the diffusion layer to consist of $TiSi_2$, $NbSi_2$, Ti_5Si_3 or Nb_5Si_3. Oxidation and defects in the coating were studied further. Results showed that the silicide coatings reduced the rate of oxidation markedly. Increasing the length of oxidation to 25 hours led to some resorption of the coating. Micro-x-ray spectral analysis showed that near the alloy-slag boundary the titanium alloy underwent enrichment due to thermodiffusion mobility and high negative free energy of the oxide. Deep oxygen penetration led to precipitation of fine needles, probably composed of titanium oxides. Figures 2; references: 2 Russian.
[179-12131]

UDC 669.295:621.785.34.061

EFFECT OF COMPOSITION OF RAREFIED MEDIUM ON GAS-SATURATED TITANIUM ALLOYS

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 21, No 2, Mar-Apr 85 (manuscript received 19 Sep 83) pp 124-126

FEDIRKO, V. N. and ZIMA, M. N., Physico-Mechanical Institute imeni G. V. Karpenko, UkSSSR Academy of Sciences, Lvov

[Abstract] High-temperature processing in a rarefied medium makes it possible to saturate titanium alloys with hydrogen, nitrogen, and oxygen. The present article reports on evaluation of the effect of certain components of a rarefied atmosphere on gas saturation and the surface state of titanium alloys. Tests were made on VT1-0 commercial titanium, alpha-alloys VT5-1 and PTZ-7M, pseudo-alpha-alloys OT4-1 and VT20, alpha + beta alloys VT3-1, VT23, VT22, and pseudo-beta-alloy VT32. Tests were made at 13.3 MPA and 1023°K for 5 hours in media of vapors of oil, CO_2 and air. After processing, metallographic study showed diffusion gas-saturated layers with lesser etching and larger granules than the core. Microhardness of VT1-0, VT5-1 and PT-7M reached maxima in CO_2, then fell. Changes in the microhardness of surfaces of pseudo-alpha-alloys OT4-1 and VT20 in oil vapors were the same as those for alpha-alloys. No carbide formation was noted in the alloys when the medium was CO_2. Residual air and CO_2, unavoidable components of rarefied atmosphere, were found to have significantly greater impact on gas-saturation processes than did oil vapors. Figures 1; references 8: 4 Russian, 4 Western.
[174-12131]

UDC 669.295'28:660.-151.62:669-153.62

HOMOGENIZATION OF β-SOLID SOLUTION UPON RAPID HEATING OF TWO-PHASE TITANIUM ALLOYS

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 59, No 1, Jan 85 (manuscript received 21 Apr 84) pp 152-159

GRUDNEV, V. N., ZHURAVLAV, A. F., ZHURAVLEV, B. F., IVASISHIN, O. M. and MARKOVSKIY, P. Ye., Institute of Metal Physics, Ukrainian Academy of Sciences

[Abstract] High temperature β phase homogenization during rapid heating is studied in a Ti-Mo alloy by mathematical simulation and experimental observation. The method used allows quantitative estimation of the influence of the two major factors determining development of the process of homogenization of the β solid solution: heating rate and initial structure dispersion. Successive quenching of specimens from increasing temperatures in the β area provides a simple and reliable method of observing the process of homogenization. This method allows experimental development of equations similar to those calculated for the β solid solution area with mimimum alloying element content.

The experimental and calculated results are similar for a heating rate of 300°K per second. Heating rate and initial structure dispersion are found to be quite significant in the Ti-10% Mo alloy studied. A method is suggested for estimating the concentration state of impoverished sectors of the β solid solution in commercial alloys during rapid heating and used to analyze the influence of heating rates and initial structure dispersion on the process of homogenization. Figures 6; references 8: 6 Russian, 2 Western.
[121-6508]

UDC 669.295

APPEARANCE OF SURFACE METALLIC FILMS DURING ELECTROLYTIC REFINING OF TITANIUM

Moscow TSVETNYYE METALLY in Russian No 10, Oct 84 pp 61-63

MAKAROV, S. B., BALIKHIN, V. S., ZVIADADZE, G. N. and KOYGUSHKIY, N. N.

[Abstract] During electrolytic refining of refractory metals in chloride solutions, a metallic film forms on the surface of the electrolyte at temperatures below 700°C. When contaminated with gaseous impurities that reduce refined metal quality, such films become a crucial problem for producing chlorides of molybdenum, titanium, vanadium and other polyvalent metals that form on the surface of the melt. The present article reports on study of surface-active components containing titanium in such films. Surface tension of $KCl-MgCl_2$ systems with added titanium dichloride was studied because of this system's relative ease in melting and the presence of cations with sharply differing ion potential. Results showed that additions of up to 0.2% titanium reduced surface tension markedly, but further additions had little additional effect. Data confirmed the hypothesis that the $TiCl_4^{2-}$-anion was the surface-active component of the saline solution. With 45% by weight $KCl-MgCl_2$ the film did not form and precipitates were evenly distributed on the cathode surface. Figures 2; references: 6 Russian.
[33-12131]

UDC 669.018:298:536.42

CHANGES IN STRUCTURE AND MECHANICAL PROPERTIES OF NIOBIUM-TITANIUM ALLOY DURING OXYGEN SATURATION

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 21, No 2, Mar-Apr 85 (manuscript received 29 Dec 83) pp 122-124

LYUTYY, Ye. M., GOMOZOV, L. I. and YELISEYEVA, O. I., Physico-Mechanical Institute imeni G. V. Karpenko, UkSSR Academy of Sciences, Lvov

[Abstract] Factors of internal and external oxidation remain present in alloys of niobium and titanium despite the improvements brought by this combination.

The present article reports on the effect of absorption of oxygen from the atmosphere on durability and plasticity of such an alloy with additional aluminum, zirconium, chromium and molybdenum. Plasticity of flat samples, measured by the angle of deviation, showed that as temperature increased from 700 to 1200°C the short-term tension strength of the alloy dropped sharply, from 550 to 20 MPa. Ocygen was also introduced internally with a slag oxygen source. An oxide phase formed after rapid cooling with needle-like structure. Granule boundaries were judged to be the location of most precipitate formation. With slow cooling (at 5°K/min instead of 50°K/min), spherical precipitates formed instead of the needle-shaped particles. All the mineral components of the alloy except chromium and molybdenum were found in the oxides that formed. Figures 4; references: 5 Russian.
[174-12131]

UDC 539.370

INTERNAL FRICTION IN TiNiCu ALLOY

Ordzhonikidze IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: TSVETNAYA METALLURGIYA in Russian No 6, Nov-Dec 84 (manuscript received 10 Nov 83) pp 83-86

V'YUNENKO, Yu. N. and LIKHACHEV, V. A., Leningrad State University; Laboratory of Strength of Materials, Scientific Research Institute of Mathematics and Mechanics

[Abstract] Results are described from measurements of the logarithmic oscillation decrement in an alloy with 50 At.% Ti + 45 At.% Ni + 5 At.% Cu, annealed for one hour at 800°C. The oscillation decrement was determined by the method of freely attenuating oscillations of a torsional pendulum at 45 Hz using cylindrical specimens with a gauge section 15 mm high, 10 mm in diameter. In some tests the metal was held at constant temperature, in others continuously heated or cooled at 2-3°C/min. It was found that TiNiCu was close in its dissipative properties to a TiNi intermetallide in terms of internal friction. No detailed study of the nature of attenuation of oscillations in TiNiCu was performed, but it is noted that apparently the change in δ in TiNiCu differs somewhat from that for TiNi. Figures 3; references 12: 8 Russian, 4 Western.
[105-6508]

UDC 621.785.54:669.295

INFLUENCE OF ELECTRON-BEAM HEATING ON STRUCTURE AND PHASE COMPOSITION OF VT9 ALLOY

Minsk VESTSI AKADEMII NAUK BSSR in Russian No 1, Jan-Mar 85
(manuscript received 18 Jul 83) pp 24-28

SHIPKO, A. A., POBOL', I. L., GORELIK, C. Ye. and KOROLEV, A. Ye., Physico-Technical Institute, Belorussian Academy of Sciences

[Abstract] A study is made of the structure and phase transformations occurring in the surface layer of titanium alloy VT9 when it is heated by an electron beam. The specimens were worked on an electron-beam welding machine modernized for electron beam surface hardening. The temperature field of the specimen was determined by calculation considering the parameters characteristic for the specific heating conditions. It was found that hot-deformed state results in the formation of a beta-transformed structure with controlled grain size varying through the thickness of the part. This allows the level of the mechanical characteristics to be changed during heat treatment. The phase composition of the hardened layer is characterized by the presence of small needle martensite and a residual alpha phase, the relative content of which is redistributed with a change in heating temperature. Figures 2; references 8: 7 Russian, 1 Western.
[166-6508]

UDC 539.67

STRUCTURE AND INTERNAL FRICTION OF NEAR-EUTECTIC ALLOY SYSTEM Ti-W TEMPERED FROM A LIQUID STATE

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 5, May 85 pp 45-48

TAVADZE, F. N., OKROSTSVARIDZE, O. Sh., DARSAVELIDZE, G. Sh. and TAVADZE, G. F., Institute of Metallurgy, GSSR Academy of Sciences, Tbilisi

[Abstract] The present article presents results of study of the structure and temperature dependence of internal friction (TDIF) of a near-eutectic Ti-W alloy system obtained from a liquid state at a cooling rate of about 10 degrees/second. The internal friction of the needle-like structure, with thickness of 50-100 mcm and length of 5-10 mm, was measured in a vacuum relaxator with a direct torsion registration at 1 Hz in a temperature range of 20-750°C. Electronographic analysis of the resulting structure showed several highly deformed phases, resulting from the high density of structural defects and high concentrations of additive atoms. There were many voi , microdoubles and defects of formation as well as traces of gases and other impurities. The unstable phase maxima are attributed to processes taking place

within or at the boundaries of the phases included in the alloy during rapid cooling. Thus in the range of 380-500°C, the saturated boron solid solution disintegrated in the alpha-titanium. Further study of these phenomena is recommended. Figures 3; references 3: 2 Russian, 1 Western.
[175-12131]

POSSIBLE MECHANISM OF WAVE FORMATION DURING DETONATION WELDING

Novosibirsk FIZIKA GORENIYA I VZRYVA in Russian Vol 21, No 1, Jan-Feb 85 (manuscript received 13 Oct 83) pp 130-137

BAZDENKO, S. V., DEMICHEV, V. F., MOROZOV, D. Kh. and POGUTSE, O. P., Moscow

[Abstract] In detonation and magnetic impulse welding, the most durable products result when wave formation occurs on the surface. Various studies have disagreed on theoretical models for this phenomenon. The present article reports on a hypothesis that states that a certain distance behind the contact point, there is a very narrow zone where viscosity drops sharply. Theoretical and experimental data are compared that show differences between magnetic impulse and detonation welding. A suppressed flow in the viscous parallel current behind the contact point is attributed to diffusion processes. The effect of thermal conductivity was discounted in considering results, which indicated that liquid viscosity was related to the suppressed flow during contact between two currents of liquid, and cumulative factors were the key to the effectiveness of penetration of the speed rotor through the liquid flow. The long submerged flow was unstable in terms of symmetrical and asymmetrical modes of oscillation. The gradual increase in wavelength was attributed to the transition from weak initial heating to rapid heating, with an accompanying change in the flow speed. Figures 4; references 10: 6 Russian, 4 Western. [142-12131]

UDC 621.039.531

RADIATION EROSION OF WELDED JOINTS IN STEELS PROMISING FOR THERMONUCLEAR INSTALLATIONS

Moscow ATOMNAYA ENERGIYA in Russian Vol 58, No 2, Feb 85 (manuscript received 1 Mar 84) pp 104-110

KALIN, B. A., POL'SKIY, V. I., SKOROV, D. M., GONCHAROV, Ye. Ye., ARTEMENKOV, I. L. and MOROZOV, A. P.

[Abstract] Results are presented from two types of action of thermonuclear plasma on a metal wall: bombardment with helium ions at 20 and 40 KeV and

irradiation by a plasma. Austenitic and ferritic stainless steels produced by powder metallurgy and traditional methods were studied. Helium ion bombardment was performed on a mass monochromator with double focus and on an accelerator. Specimens were cut from the area of welded joints in sheets of steel 0.8-1.5 mm thick. Photographs of the microstructure of steel following bombardment and irradiation are presented. The nature and degree of radiation erosion of the welded seams changes significantly in the direction perpendicular to the line of the seam due to the different structural and phase conversions occurring upon uneven heating in the process of welding. Erosion depends on the type and composition of the material. Welding of steels and alloys increases erosion near the welded seam due to changes in the microstructure of the material, redistribution of alloying elements and the effects of internal thermal stresses. Figures 5; references 13: 11 Russian, 2 Western.
[160-6508]

UDC 621.791.4.03

OPTIMIZATION OF TECHNOLOGICAL PARAMETERS OF COLD PRESSURE WELDING OF AD1M THIN ALUMINUM SHEETS

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 4, Apr 85, pp 9-11

KUZIN, V. F., candidate of technical sciences, SAVINKIN, Yu. V., engineer, TSYPONA, M. N., candidate of technical sciences, KOZELO, Ye. A. and ARKHANGEL'skiy, M. a., engineers, Tula Polytechnical Institute

[Abstract] In order to study the influence of tool geometry, tool surface condition, welded material thickness and degree of deformation on the quality of joints produced by cold pressure welding with minimum deformation of the material, a regression analysis was performed on data from an experiment involving cold pressure welding of thin AD1M aluminum sheets (0.3, 0.5 and 0.8 mm thick). It was found that under the experimental conditions used, the length of the welded zone was most greatly influenced by the angle of the tip of the tool used. The optimal angle is 7 degrees. Increasing friction on the contact surface causes an increase in the size of the welded zone, particularly where the tool angle is low or the material is thick. The quality of welding is influenced by the thickness of the welded material. With minimum friction on the contact surface, as the thickness of the material increases, 1/S decreases. Maximum friction of the compact surface increases 1/S as the material increases, particularly where the tool angle is low. Figures 5; references: 5 Russian.
[163-6508]

UDC 621.791.754'293.052:669.715:539.4

STUDY OF PROCESS OF PORE FORMATION DURING ARGON-ARC WELDING OF ALUMINUM ALLOY 1420

Kiev AVTOMATICHESKAYA SVARKA in Russian No 4, Apr 85 (manuscript received 15 May 84; in final form 19 Jun 84) pp 21-26

ABRALOV, M. A., doctor of technical sciences, ABDURAKHMANOV, R. U., candidate of technical sciences and ABDURAKHIMOV, A. A., engineer, Tashkent Polytechnical Institute

[Abstract] The lack of a commonly accepted opinion concerning the source and mechanism of formation of pores during welding of 1420 aluminum alloy hinders control of this defect. A study was therefore made to determine the specifics of pore formation and refine the source of porosity in argon-arc welding of the alloy. Experiments were performed on rectangular specimens 90 x 22 x 1.6 mm which were melted clear through. Butt joints were produced using two specimens of the same size. The major reason for the significant porosity of the alloy was found to be the presence of methane which is formed primarily in the surface layer of the metal. Rapid evolution of the methane mixed with hydrogen begins from the base metal in advance of the melting front and continues in the liquid metal bath. The constricted conditions for floating of gas bubbles generated near the melting zone at the root of the seam as well as continuous delivery of methane and hydrogen from the solid metal lead to the formation of a chain of large pores. Figures 8; references: 3 Russian. [167-6508]

UDC 621.791.4.011:539.378.3

INFLUENCE OF THERMAL CYCLE ON CHARACTERISTICS OF CYCLICAL CRACK RESISTANCE OF TITANIUM ALLOYS AND THEIR JOINTS PRODUCED BY DIFFUSION WELDING

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 1, Jan 85, pp 34-36

KARAKOZOV, E. S., doctor of technical sciences, VASIL'YEVA, S. S., doctor of technical sciences and IVANOV, S. V., candidate of technical sciences, Moscow Evening Institute of Metallurgy

[Abstract] Linear fracture mechanics was used to analyze the behavior of titanium alloys VT6Ch and VT16 and welded joints with defects. Specimens of VT16 were annealed to imitate the thermal cycling of diffusion welding at 860 and 960°C, while specimens of VT6Ch were heated to 800, 940 and 1050°C. The crack resistance of the material with a welded seam and imitation thermal cycle of diffusion welding was determined. The cyclical strength of welded joints in VT6Ch was found to be higher than in the base material with stress amplitudes below the yield point, probably resulting from the hardening effect of the martensitic alpha prime phase formed as a result of the beta-alpha prime

transformation in the zone of plastic deformation in advance of a propagating crack during cyclical loading. Figures 9; references 5: 4 Russian, 1 Western.
[162-6508]

UDC 621.791.4:539.378.3

KINETICS OF DISSOLUTION OF OXIDE FILMS IN TITANIUM UPON DIFFUSION WELDING

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 4, Apr 85, pp 35-37

PESHKOV, V. V., candidate of technical sciences, KHOLODOV, V. P., engineer, VORONTSOV, Ye. S., doctor of technical sciences, Voronezh Polytechnical Institute

[Abstract] A study was made of the process of dissolution of oxide films in titanium and its alloys. Experiments were performed on specimens 16 mm in diameter and 2 mm thick of tehnically pure VT1-0 titanium and the alloys OT4 and VT6. The surface was polished, degreased and oxidized in air for $1.8\text{-}2.4 \cdot 10^3$ s at 773 (VT1-0), 873 (OT4) and 898 (VT6)°K until a bluish oxide film appeared. Two oxidized specimens were heated in a vacuum chamber at $6 \cdot 10^{-2}$ Pa air pressure simultaneously, separated by a titanium foil washer 0.1 mm thick to prevent contact between the surfaces. The thickness of the oxide film was measured after heating to determine the amount of dissolved oxide layer. A basic difference was established in the kinetic curves for technically pure titanium and titanium alloyed with aluminum. In technically pure titanium, the curve indicates a decrease in the rate of the process as time passes, while in the alloys with aluminum there is a clear bend in the curve, which appears to be a combination of two parabolas. Figures 4; references: 9 Russian.
[163-6508]

UDC 621.791.052:620.18

INFLUENCE OF PRELIMINARY ANNEALING ON STRUCTURE AND PROPERTIES OF VT23 ALLOY WELDED JOINTS AFTER HARDENING

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 4, Apr 85, pp 16-18

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[Abstract] Results are presented from a study of the influence of preliminary annealing before hardening on the structure and properties of welded joints in

VT23 alloy made by argon-arc welding with type SPT-2 welding wire. Hot-rolled plates 30 mm thick were welded, then heated at 800°C for one hour, cooled in air and aged at 500°C for ten hours. Preliminary annealing was performed at 775 to 875°C for one hour with cooling with the furnace before hardening heat treatment, farming larger alpha plates and a smaller number of crystalline structure defects than when a lower heating temperature was used. The combination of preliminary annealing at 850°C plus standard hardening increases ductility, impact toughness and homogeneity of mechanical properties of welded joints in the alloy in comparison to similar heat treatment but without annealing. Figures 5; references: 8 Russian.
[163-6508]

UDC 621.791.052:669.295:620.193.4

CORROSION RESISTANCE OF WELDED JOINTS IN CERTAIN TITANIUM ALLOYS

Kiev AVTOMATICHESKAYA SVARKA in Russian No 4, Apr 85 (manuscript received 14 Jun 84; after revision 20 Sep 84) pp 19-20

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[Abstract] A study is presented of the corrosion resistance of welded joints in technical titanium VT1-0 and low alloy titanium alloys OT4-1, PT-3V, AT3 and AT6. Disk-shaped specimens 30 mm in diameter and 4-6 mm thick with a circular bilateral seam 40 mm in diameter were studied. Specimens were prepared by manual argon-arc welding with a tungsten electrode, wire diameter 2 mm. Tests were performed in concentrated 99% nitric acid at the boiling point for 3030 hours. The studies showed that welded joints in titanium alloys are subject to corrosion cracking at minimal corrosion rates. This must be considered in selecting titanium alloys as materials for the manufacture of welded structures and in corrosion testing under stress not only of alloys but also of welded joints. Figures 2; references 7: 6 Russian, 1 Western.
[167-6508]

UDC 621.791.052:669.295:[539.38+539.4.014]

DEFORMATION AND STRESSES UPON WELDING OF VT23 TITANIUM ALLOY

Kiev AVTOMATICHESKAYA SVARKA in Russian No 2, Feb 85 (manuscript received 22 May 84) pp 41-43

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[Abstract] Results are presented from experiments studying full longitudinal deformations and residual stresses in welded joints in VT23 alloy. Butt joints in plates measuring 250 x 200 x 6 mm made by argon arc welding with a tungsten electrode and FAN-1 flux were studied. Welding was performed in two passes without finishing of the edges from one side. No welding wire was used. Two methods of heat treatment were used: annealing at 750°C, 1-2 hours with cooling in air and subsequent two-stage aging at 380°C, eight hours plus 550°C, two hours; annealing of individual parts before welding, then aging of the welded joint. Residual longitudinal elongation deformations were produced by welding rather than shortening, resulting from phase transformations upon cooling in the 750-550°C temperature interval. Heat treatment of welded joints consisting of annealing and aging or aging alone leads to complete relief of residual stresses, which may amount to 30% of the tensile strength of the base metal. Figures 3; references: 4 Russian.
[135-6508]

UDC 621.791.052:539.4.014

DETERMINING LOCAL HEATING PARAMETERS FOR INCREASING FATIGUE RESISTANCE OF WELDED JOINTS

Kiev PROBLEMY PROCHNOSTI in Russian No 4, Apr 85 (manuscript received 10 May 84) pp 32-36

MAKSIMOVICH, V. N., CHABANENKO, A. A., MIKHEYEV, P. P., GUSHCHA, O. I. and KUDRYAVTSEV, Yu. F., Lvov, Kiev

[Abstract] Artificial means of imposing beneficial residual compression tension in concentration zones have been used to increase the bearing strength of metal designs that are subject to varying load conditions. Gas heating has been used effectively to counteract stretching under load. The present article offers a theoretical determination based on thermoplasticity of optimum parameters for strengthening laminates when the heat is applied to a relatively small section of the test metal and heating is by convection at a temperature

that can be described by a Hauss distribution. The temperature field and the tension generated are regarded as constants. The most common methods of final differences and final elements were rejected in favor of integral-differential equations to show thermoplasticity. Various forms of statistical treatment are presented. They indicate that the effect of external load leads to changes in the fields of applied residual tension. An inverse relationship was noted; it was more pronounced with biaxial stretch. Maximum residual tension was obtained at 400-500°C. Within usual limits for fatigue of welded joints, reduction of residual compression tension did not exceed 30% of initial values. Figures 4; references 11: 9 Russian, 2 Western.
[168-12131]

UDC 621.791.4.01:539.378.3:669.245.018.44:620.18

INFLUENCE OF STRUCTURE OF HEAT-RESISTANT NICKEL ALLOY ZhS6U ON ITS WELDABILITY IN THE SOLID STATE

Kiev AVTOMATICHESKAYA SVARKA in Russian No 2, Feb 85 (manuscript received 16 Mar 84; in final form 02 Jul 84) pp 13-16

GOLUBEV, V. N., candidate of technical sciences, SHARIF'YANOV, F. Sh., and VLASOVA, A. V., engineers, Ufa Aviation Institute imeni S. Ordzhonikidze

[Abstract] A study was made of the influence of various structural characteristics of heat-resistant alloys and the phenomenon of superplasticity on the formation of a welded joint by diffusion welding. Studies were performed on heat resistant alloy ZhS6U in the cast state and the same alloy obtained from granules by powder metallurgy. Tests were performed in the 960-1200°C temperature interval at deformation rates of $1 \cdot 10^{-4}$ - $1 \cdot 10^{-1}$ S^{-1} and showed significant differences in mechanical properties of the alloys obtained by different methods, related to the structural state of the alloy. The cast alloy has low ductility and high resistance to plastic deformation, whereas the powder metallurgy product shows all the signs of superplasticity at 1050-1150°C. The structure formed upon heating to the welding point has decisive influence on the weldability of heat-resistant nickel alloys. The best-quality welded joint is obtained under temperature and speed conditions corresponding to the range of superplastic deformation of the alloy. Figures 3; references: 7 Russian.
[135-6508]

UDC [621.791.052:621.772.46]:539.4.001.24

RESERVES FOR DECREASING METAL CONSUMPTION OF WELDED VESSELS OPERATING AT 293°K and 77°K

KIEV AVTOMATICHESKAYA SVARKA in Russian No 2, Feb 85 (manuscript received 22 Jun 83; in final form 17 Apr 84) pp 6-12

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[Abstract] Branch standard OST 26-04-2585 was used to calculate the strength, stability, and durability of thinwall envelope structures for cryogenic purposes considering only low-temperature hardening of materials. To develop a general principle allowing estimation of both deformation and low-temperature hardening of materials of low and moderate strength, widely used for the manufacture of envelope structures, the author suggests an improved energy approach which more accurately considers the physical processes of deformation and rupture of such materials. That portion of the energy absorbed by the material related to the process of deformation or low-temperature hardening in the zone of uniform deformation (the work of plastic deformation) is considered to increase and refine the values of permissible stresses. Standard strength and ductility characteristics are used and all computations are simplified, since an engineering approach is desired. A significant increase in permissible stresses is calculated only for vessels made of 304SS steel. Figures 3; references: 7 Russian. [135-6508]

UDC 621.762

DIFFUSION WELDING OF COPPER-CHROMIUM PSEUDOALLOY WITH COPPER

Kiev POROSHKOVAYA METALLURGIYA in Russian No 10, Oct 84 (manuscript received 28 Jul 83) pp 45-47

SYSOYEV, A. P., SERGEYEV, A. V. and KAZAKOV, N. F., Moscow Aviation Technology Institute

[Abstract] A study is made of the possibility of diffusion welding of a Cu-Cr pseudoalloy with copper. Welding was performed on an SDVU-26 machine. Before the parts were placed in the chamber, the surfaces of the copper and alloy were cleansed of oxide film, degreased with acetone and dried with ethyl alcohol. Strength of the joints was studied as a function of temperature and time of isothermal holding. It was found that during vacuum annealing, chromium oxides appeared on the free surface of the alloy. The degree of oxidation during heating of the materials in contact was less, but the lower oxide of chromium was still formed. When welded under conditions producing the maximum joint strength, the hardness of the alloy dropped from 140 to 97 HRB, primarily as a result of annealing of the copper matrix. The hardness of the alloy can be improved by deforming the diffusion welded plates, with a degree of relative deformation of the copper component of the bimetal of 10-13% yielding best results. Figures 4; references: 3 Russian.
[76-6508]

UDC 621.791.052-462:539.4:669.788

INFLUENCE OF HYDROGEN ON FORMATION OF COLD CRACKS IN SEAMS DURING WELDING OF PIPE STEEL

Kiev AVTOMATICHESKAYA SVARKA in Russian No 2, Feb 85 (manuscript received 11 Jan 84; in final form 12 Mar 84) pp 1-5

MANDEL'BERG, S. L., doctor of technical sciences, BUSLINSKIY, S. V., engineer and BOGACHEK, Yu. L., candidate of technical sciences, Institute of Electric Welding imeni Ye. O. Paton, Ukrainian Academy of Sciences

[Abstract] A study was made of the cold crack resistance in seams of low-alloy steels welded using conditions and materials similar to those used for the production of large-diameter pipe. Double-sided, two-layered welded joints were studied in materials of three types: steels of test rolls microalloyed with vanadium and niobium, normalized steel microalloyed with vanadium, and normalized steel containing no microalloy elements. Rolled sheets of various thicknesses characteristic for the production of pipes were used. It was found that when welded joints of these steels are allowed to cool naturally, cracks do not form, the level of concentration of diffusion hydrogen being comparatively low.

This indicates that the seams of large-diameter pipes, including those made of microalloyed steels by existing technologies, have acceptable resistance to the formation of cold cracks resulting from the presence of hydrogen. Increasing the alloying of seams, forced cooling, and increasing metal thickness facilitate the formation of transverse cracks in microalloyed steels. Seams made of type 09G2FB steel have significantly higher resistance to the formation of such cracks than 16G2SAF steel. Figures 4; references 10: 5 Russian, 5 Western.
[135-6508]

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